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CONCRETE ON THE FARM

THE ATLAS PORTLAND CEMENT COMPANY

NEW YORK CHICAGO

INDEX

Concrete on the Farm

The Atlas Portland Cement Company

Members of the Portland Cement Association

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Chapter 1—Why you should use concrete

YOU are planning to build—a garage or a barn perhaps, a watering trough, feeding floor, hog pen, chicken house or root cellar. No matter what it is, there are certain questions that are bound to occur to you:

1. Can I do the job myself with my help right here on the farm? Or must I get special assistance from outside?
2. Can I use some of the materials I have right here on the farm? Or must I buy all my materials and perhaps wait for deliveries?
3. Is the job going to cost me much? Or can I keep the initial expense down fairly low?
4. Will it cost me a good deal for upkeep and repairs when done? Or can I count on practically no expense after first cost?

Whatever you build, these questions will come up. And the answer depends not so much on *what you are going to build* as on *what you are going to build it with.*

If you build of wood, you will have low first cost, but repairs and upkeep will be high, and you will not have fireproof construction. Brick and building stone are both expensive, and may be hard to get.

If, on the other hand, you build in concrete, these questions will be answered favorably. You may even be able to decrease your costs greatly by using sand and gravel or stone from your own farm. Therefore, with concrete in mind, let us take up each point to be considered.

1. Almost everything described in this book can be built *by you*, with ordinary farm help from the instructions in this book.
2. All the materials necessary for concrete construction can be procured almost anywhere. The cement you can get from your local dealer. The sand and gravel or stone you probably can get right on your own farm or nearby, at no cost except labor.
3. Concrete construction is economical to build. A concrete sidewalk, for instance, will cost you about 15 cents a square foot —$15 in all for a walk 50 feet long and 24 inches wide. It will cost still less if you can get the sand and gravel or stone from your own farm.
4. Concrete costs almost nothing for upkeep, because it is waterproof, fireproof, rotproof, rustproof, verminproof and, to a greater degree than anything else made by man, timeproof. *What you build with concrete you won't have to rebuild or repair.*

But don't think of just those four questions.

Think of building construction on the farm *as an investment.* You are *putting value into* the building whether you hire outside labor or expend your own efforts. And so you ought to consider *what* you are going to *get back.*

What are the dividends you get from your investment in concrete?

First, concrete construction means permanency. On many constructions you pay a yearly charge for permanency. You pay it in fire insurance and the cost of wear and tear or upkeep. Concrete construction, of course, is fireproof; it saves fire insurance by lessening the premium on both building and contents or by making it unnecessary for you to insure the building. Concrete does not wear out—there is no constant fixed charge each year for renewal, painting, etc.

Building in concrete is a precaution against sickness and death for your stock, and against vermin and filth. You buy this insurance for a single initial payment. There are no annual payments afterward.

Concrete stable floors, concrete water tanks, and concrete drains will suggest themselves to you as examples of conservation and increased value to your property. Farm sanitation in cow-barns and every other part of the farm is one of the great steps forward in

modern hygiene, affecting not only the country but the whole nation, which now gets milk for its babies and grownups from cleaner, healthier dairy-farms than it did twenty years ago. And concrete more than any other building material has made this possible.

Looking at the whole matter from still another side, you will see that concrete construction actually *brings in money:*

If you have a sanitary cow-barn floor, you have cleaner milk and healthier cows—in other words, *more money.*

If you have a concrete silo, you preserve your silage better and more economically, and get more feeding value out of it. This is transmuted into beef, veal, milk, butter—in other words, *more money.*

If you build concrete manure pits, you can return to the soil practically all the strength of natural fertilizer, instead of letting 30 to 50 per cent of it wash away in heavy rains or dry up from too little moisture. That will mean that you will get bigger crops—in other words, *more money.*

If you have concrete drains in your fields, you increase their productivity, extend your season, check rain-washing or erosion, and assure yourself a bigger and better yield—in other words, *more money.*

What this book is about

What we have said so far has been to place before you the advantages of using concrete.

The next chapter will tell you what concrete is and how to make it.

At the end of chapter 2 we tell you something about our *Technical Department.* By "our" we mean something that belongs to you as well as to the Atlas Portland Cement Company. By *Technical Department* we mean a group of men who are in our employ because they know how to use concrete to the best advantage. They are here to serve you, by giving you free advice and assistance on problems that come up on *your* farm. For help that you want and can't find in this book, write to The Atlas Technical Department.

The third chapter takes up the different jobs you can build of concrete and explains how to build them. Most of the structures are simply constructed and may be built with farm labor. The larger constructions, such as barns, silos, etc., where more experienced help is required, are only briefly described and the text advises you to consult a contractor for such jobs. Work that you may execute yourself is carefully explained and illustrated.

Chapter Four tells you about Concrete Roads—not so that you will build these roads yourself, that is, with your own labor; but so that you will help to get them built by your county or state officials.

Then comes a chapter on Atlas Portland Cement. Concrete, as we have just seen in our talk, is the wisest, safest, cheapest material for you to use in building on the farm. *Portland Cement* is the most important material used for making concrete. *Atlas* Portland Cement is the *standard* by which all other makes are measured. So there is a good reason for your knowing about it if you are interested in any farm construction work.

We have made a list below of the various things which are of importance in using concrete. You will need to know a great deal about the first 6 subjects, whatever you build.

I. Materials required and their selection
 Cement *Stone or gravel*
 Sand *Water*
II. Proportioning materials
III. Mixing concrete
 Hand mixing *Machine mixing*
IV. Placing, depositing and protecting concrete
V. Forms for concrete.
VI. Surface finishing
 Rubbed or floated finish.
 Mortar facing

You may want to know something about Nos. VII to X—it depends on what you build.

VII. Bonding
VIII. Waterproofing
IX. Reinforcing
X. Concrete in winter

Chapter 2—How to make concrete

I. Materials required and their selection

1. Concrete is made up of three materials: (1) Portland cement, (2) sand, and (3) screened gravel or stone—mixed with water. (Portland cement and sand *alone*, mixed with water, form *mortar*.) Portland cement is a manufactured product, finely pulverized in form, which you can buy nearly anywhere in the world, in bags; its purpose is to bind (or cement) together the particles of sand and stone. Sand and stone are found in abundance on most farms, or nearby; they make up the bulk of the mixture that the Portland cement binds together, and in the building trades they are called "aggregates." Sand is a *fine* aggregate. Stone is a *coarse* aggregate.

Portland cement

2. You need not know all the technical details of the chemical composition and manufacture of Portland cement to use concrete. But you must know the few things that really affect its use in making concrete.

3. Portland cement comes from the mill in a very finely powdered or floury form. To be a good binding material, cement must have the property of hardening or "setting." It does this when it comes in contact with water in any form. When it has once been wet and becomes hardened, it is useless as a binding material. Therefore, in storing cement, be sure to keep it *absolutely* dry, away from any kind of moisture or dampness. *Don't leave it on the ground:* The ground is likely to have some moisture in it.

4. The weight of the cement itself in the bag, or of one bag upon another as it is piled in a car or storage shed, may make it hard or lumpy. Such lumps or hardening do not affect the quality of the cement or its power to set. They break up in mixing. To tell if a lump is due to this "pressure caking," see if it will crumble when it is pinched between the fingers. If not, don't use it—its cementing value has been destroyed.

Fig. 1—Atlas Portland Cement—The standard by which all other makes are measured. A bag contains approximately a cubic foot.

5. Once Portland cement begins to set, the operation of setting must be continuous and uninterrupted, or the result will not be thoroughly satisfactory. To secure what is called the proper curing of concrete, moisture must be supplied all the time it is taking its set, and all this time the mass of the concrete must not be disturbed.

Note.—It should be carefully noted here that "Portland" is not a brand name but is a descriptive term, used because the first Portland cement was about the same color as the famous limestone quarried on the Island of Portland. Today there are many brands of "Portland" cement manufactured in the United States. They vary just as different brands of flour or any other product vary. Therefore, you should always state the brand name first, insisting on *ATLAS* Portland Cement, instead of only asking for Portland Cement. Then you will be sure of high uniform quality and the best results. Cement is the most important ingredient in concrete. The less you know about concrete, the safer you will be with a good, standard product. The name *ATLAS* ensures that.

On pages 92 to 94 is the story of Portland cement.

Aggregates for concrete

6. Aggregate is the hard material—sand, gravel, stone, etc., that is mixed with Portland cement and water to make concrete. Aggregates are of two kinds—fine and coarse.

7. A *fine* aggregate is one the particles of which will pass through a screen with ¼-inch openings. For fine aggregate the material commonly used is sand or fine quarry screenings of stone.

8. A *coarse* aggregate is one the particles of which will *not* go through a ¼-inch screen and are usually not larger than 2½ inches. Gravel or broken stone is the most common material for coarse aggregates. Sometimes pebbles are used.

9. Aggregates, fine and coarse, are *graded* by the average size of the particles, that is their diameter. This is most easily measured by testing with different size screens. Different grades (or sizes) are used for different kinds of construction.

10. Getting the right sort of aggregate is going to be much more difficult for you than getting good cement, because Atlas Cement is carefully manufactured and thoroughly tested in order to make sure that it is uniform, but aggregates are untested raw materials. So you will have to test them yourself, particularly if they are sand and gravel that you get from your own farm or from a nearby gravel pit, where they have not been properly screened and graded.

11. In choosing your aggregate, remember that a concrete cannot be harder than the aggregate of which it is made. If cinders or broken brick are used, the concrete will be porous and weak, like the aggregate. For strong concrete, use a firm hard aggregate. For concrete work that is going to be exposed to the elements, avoid the use of any aggregate which is porous and will absorb moisture.

Sand (fine aggregate)

12. For concrete work, *sand* is defined as clean rock particles, free from loam, clay or other foreign substance, varying in size from fine to those that just barely pass through a screen with ¼-inch meshes (4 meshes to linear inch; 16 meshes to square inch).

13. It is essential that the sand should be a mixture of fine and coarse particles—with more particles coarse than fine. There must be some finer particles because these smaller particles fit about and between the coarse particles, and fill in the empty spaces or voids between them. Figure 2 shows fine, coarse and graded sand in actual sizes. The graded sand in the center is best, because it contains both fine and coarse particles.

14. Good sand also *must be both hard* and *clean*.

15. The sand particles *must be hard*. The definition says "*rock*" particles. People also often say that sand for concrete must be "sharp," but that does not mean that the fragments need to be angular. All that is necessary is that the particles be really *hard*.

16. The sand *must be "clean"*—free from foreign substances. Vegetable or animal impurities, even in small quantities, may render the sand unfit to use in concrete. These impurities coat the sand particles so that the cement cannot stick to them and cannot bond as it should.

17. If you dig your sand from a bank, be careful to take off all the top soil first, and then there will be no chance of loam sliding into the pit and mingling with the sand. If

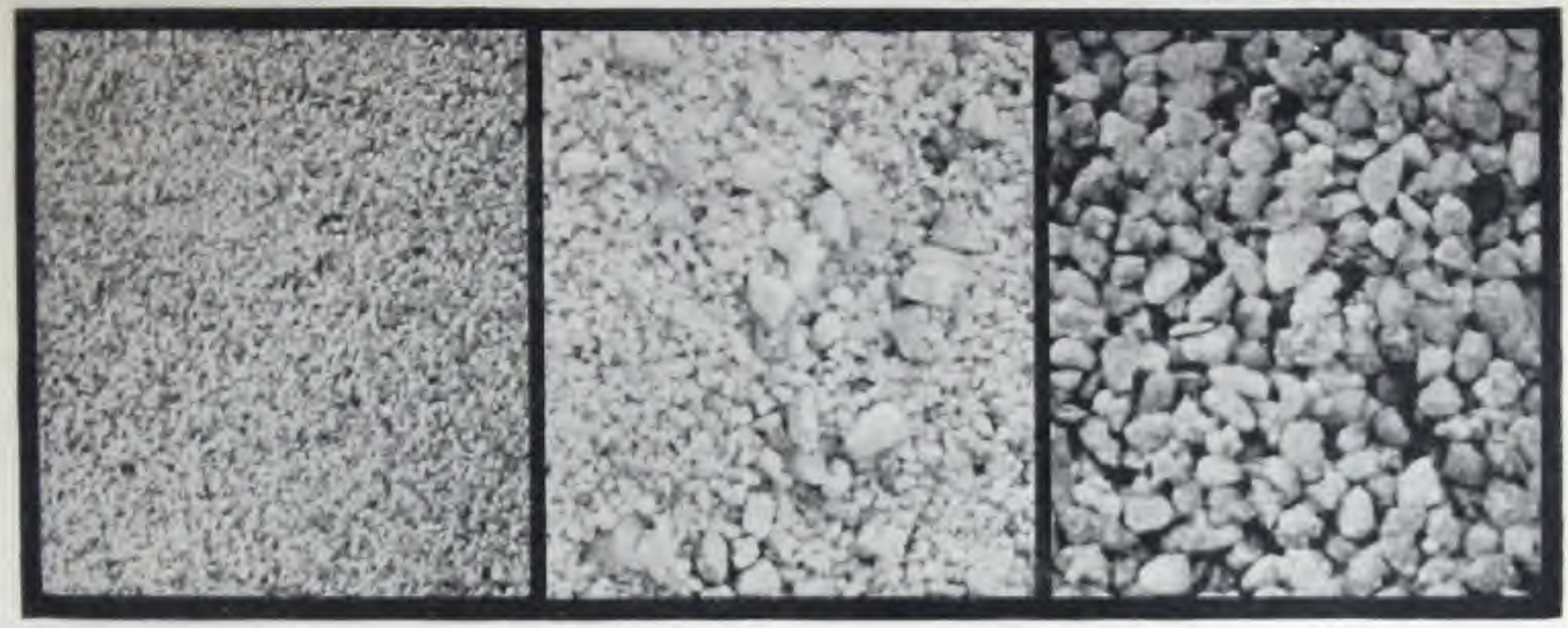


Fig. 2

A—All fine sand (actual size), passing 30-mesh sieve, but retained on 50-mesh sieve. 50% is voids.

B—Well graded sand (actual size) —*A* and *C* mixed—from 6 mesh to 50 mesh in uniform proportions; only 42% voids.

C—All coarse sand (actual size) passing 6-mesh but retained on 8-mesh; 53% of this is voids.

you have any reason to doubt the cleanness of the sand, test it before using; otherwise, it may mean that all your labor and material will have been wasted.

18. *How to Test Sand for Impurities.* Rub the sand, moist as it comes from the bank, between the palms of the hands lightly. If your hands stay clean after this, the sand is comparatively free from loam. If your hands are discolored, the sand is not clean and needs to be washed to remove the dirty loam before using for concrete.

19. You can find how much foreign matter there is in sand by putting enough sand in a glass fruit jar to come four inches high and then putting in enough water to come within an inch of the top. Shake the jar well and give the contents an hour to settle. The sand will go to the bottom. Any loam there is will lie on top of the sand, and it will be easily recognized by its color. If this layer of loam is more than ¼ inch thick, the sand must be washed before using.

20. *How to Wash Sand.* Washing sand by wetting the pile with a hose is wrong—it only transfers the dirt to the lower part of the pile. The right way is for one man to shovel it on the upper end of a trough, like the one shown in Figure No. 3, while another man washes it down the incline by pouring water on it. There is a fine screen (size of mosquito netting) cleated to the incline. When the sand and water come to this screen, the dirty water drains through and leaves the clean sand ready for use.

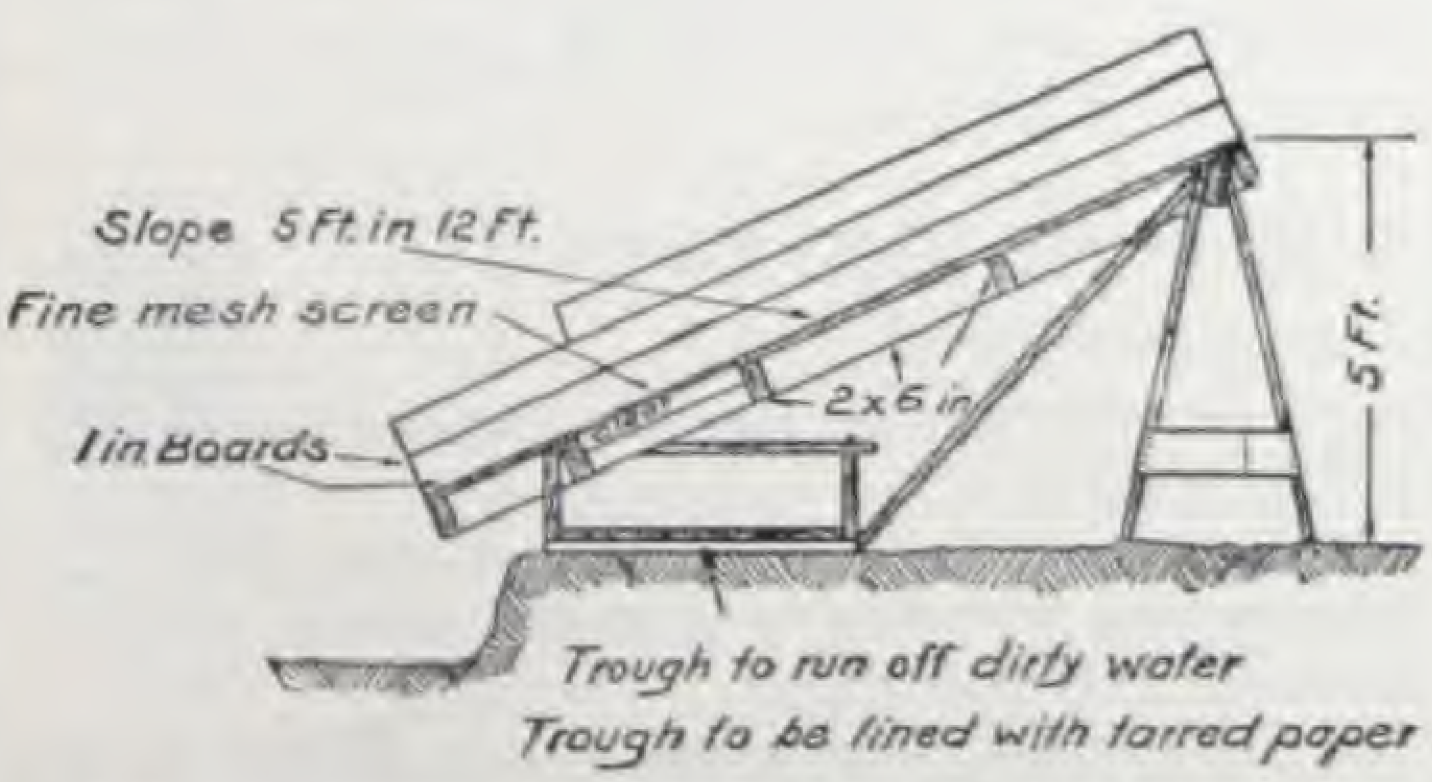


Fig. 3—Temporary device to screen and wash sand.

Fig. 4—Screen for sand—¼-inch mesh.

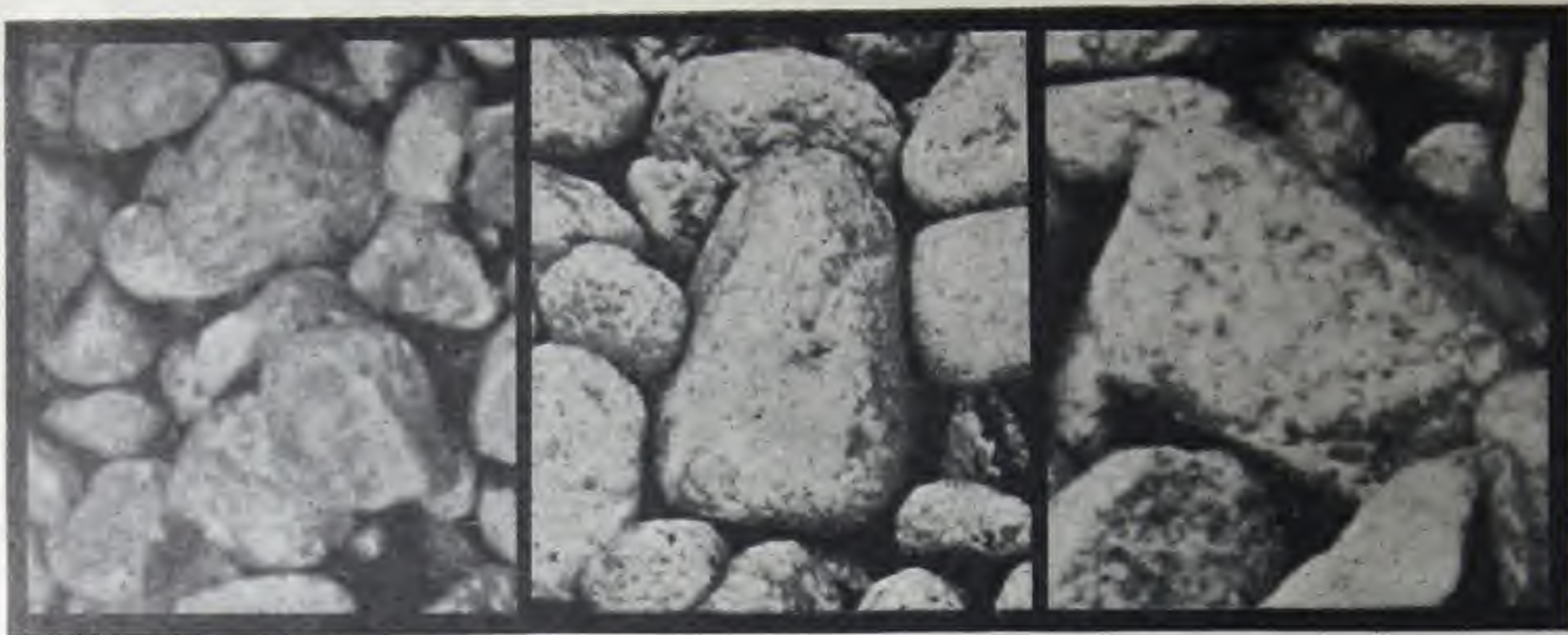


Fig. 5

A—All small gravel (actual size). Particles between ¼ and ½ inch in diameter. 42% is voids.

B—Well graded gravel (actual size) Particles from ¼ to 1 inch in uniform proportions. 38% voids. A mixture of *A* and *C*.

C—All large gravel (actual size). Particles between ¾ and 1 inch. 49% voids.

Crushed stone or gravel (coarse aggregate)

21. To distinguish between fine aggregate (sand) and coarse aggregate (gravel or stone) we choose a certain size (one-quarter of an inch) and say that particles smaller than ¼-inch are to be classed as fine aggregate, and particles larger than that are to be classed as coarse aggregate.

22. Coarse aggregate should be clean and free from impurities. They may be washed the same as the fine aggregate.

23. These coarse aggregates also should be graded, from fine to coarse, with coarse particles predominating. The coarse particles ought not to be more than 2½ inches in diameter at the largest part, for ordinary construction.

24. Remember this: Don't use any pebble or piece of broken stone if its greatest dimension is more than one-half the thickness of the concrete you are placing.

25. *Bank-Run Gravel.* The usual, natural mixture of sand and pebbles as it comes from the ordinary gravel bank contains more or less foreign matter, and should be washed thoroughly before it is used.

26. Washing is easily done, especially if the gravel bank is right at the site of the work —see Figure 3. The sand and gravel are shoveled on the upper end of the platform and washed down the incline with water. The dirty water drains off through the screen and the clean material falls from the lower end of the platform.

27. Bank-run gravel usually contains such varying amounts of fine and coarse aggregates that it should be screened before using, separating the fine aggregate from the coarse aggregate and remixing in proper proportions—see Figure 4.

Summary of directions for choosing aggregates

28. In choosing aggregates these rules are to be remembered.

1. All aggregates must be free from vegetable matter, dirt or other foreign substances.

2. To use bank-run gravel, separate the sand from the stone and pebbles by screening through a ¼-inch screen.

3. For fence posts and other small concrete units, the fragments of coarse aggregate (crushed stone or gravel) should be ¼ to ½ inch in diameter. For larger construction the size may range from ¼ inch to 2½ inches.

4. Sand must be coarse, hard and clean, with particles graded from fine to ¼ inch diameter, with the large size predominating.

5. The largest dimensions of the stones in the coarse aggregate should not be more than one-half the thickness of the wall or slab of concrete.

How to get expert advice on your problems—see page 19.

Water for concrete

29. Use nothing but clean water. Scummy, dirty, muddy or alkaline water must not be used. A good drinking water is always right to use for mixing concrete. The amount of water to be used varies with the material used and results desired. See Mixing, page 10.

II. Proportioning the materials

30. By "proportioning" we mean determining the necessary quantities of cement, sand and gravel or crushed stone, which you should use in doing your work. Cement is always the smallest quantity in a mixture for making concrete and is *always mentioned first*. It comes in bags containing approximately one cubic foot each, so the amount of cement is taken as the unit of measurement and the quantities of the other materials are compared with it. The *second figure* is always the number of parts of sand (fine aggregate). The *third figure* is the number of parts of stone or gravel (coarse aggregate). Thus, when we speak of a 1:2:4 mixture, we mean that to every cubic foot (bag) of cement there are two cubic feet of sand and four cubic feet of gravel or stone.

31. You can get satisfactory results only by proper proportioning.

32. The object of proportioning is to make a sufficiently dense concrete mixture. Sand or gravel or crushed stone, alone, have between their particles empty spaces called "voids." To make dense concrete the cement, sand and stone must be proportioned so that the voids in the coarse aggregate are filled with the finer particles of sand and cement, and so that the voids in the sand are filled and bound together with particles of cement.

33. If you bear in mind what has been said about voids—that sand fills in voids in the stone, and that the cement fills in the voids between the grains of sand—then you will not make the common mistake of estimating that *one* cubic foot of cement, *two* cubic feet of sand and *four* cubic feet of stone will make seven cubic feet of concrete. Because so much of the material is used up filling voids, the actual total quantity of concrete obtained by mixing these quantities of aggregates is only a little more than the quantity of stone—four cubic feet—see Figure 6.

34. For almost all work twice as much coarse aggregate (gravel or stone) must be used as fine aggregate (sand).

35. The following are typical mixtures.

Rich Mixture—1 part cement, 1½ parts sand, 3 parts aggregates (used for concrete roads and waterproof structures).

Standard Mixture—1 part cement, 2 parts sand, 4 parts coarse aggregates (for reinforced work, floors, roofs, columns, arches, etc., and for tanks, sewers, conduits, etc.)

Medium Mixture—1 part cement, 2½ parts sand, 5 parts coarse aggregates (for foundations, walls, abutments, piers, etc.)

Lean Mixture—1 part cement, 3 parts sand, 6 parts coarse aggregates (for all mass concrete work, large foundations backing for stone masonry, etc.)

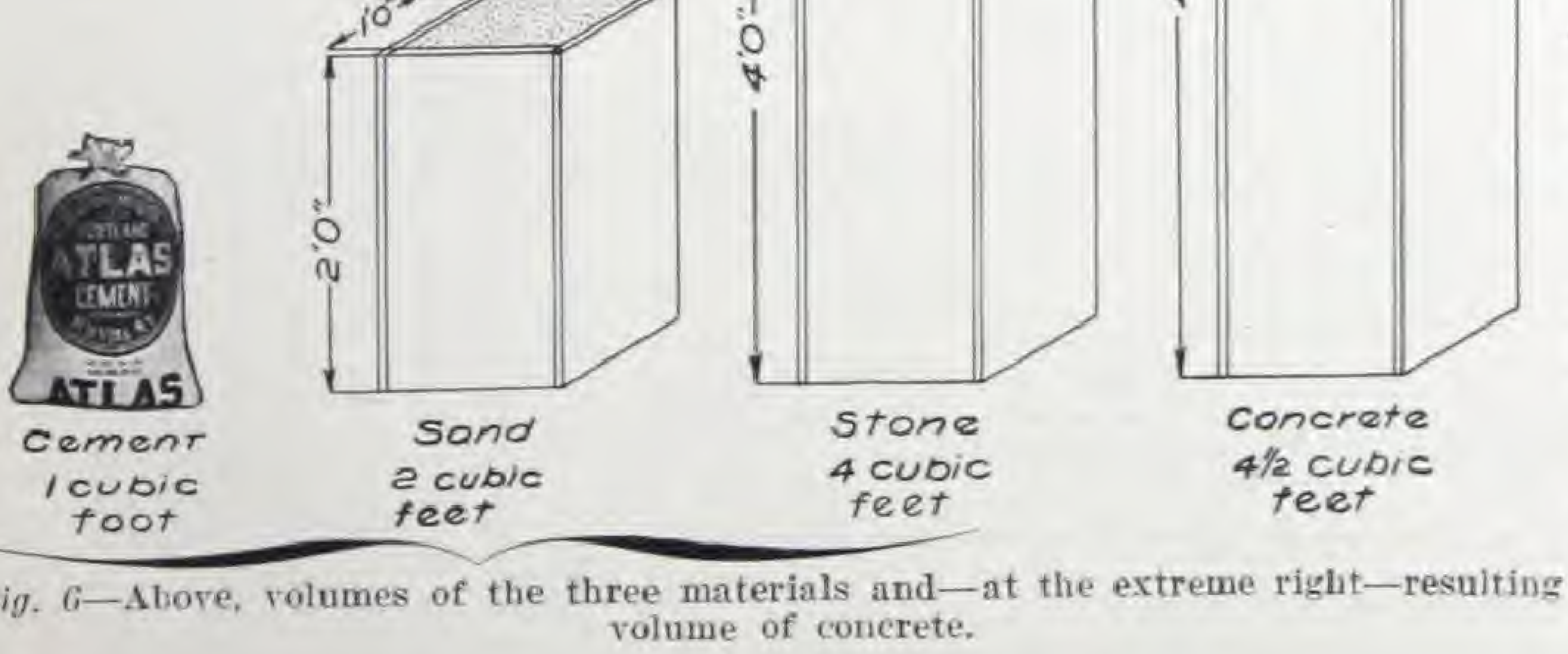


Fig. 6—Above, volumes of the three materials and—at the extreme right—resulting volume of concrete.

Table of materials required on page 8.

Table for determining quantities of materials needed

36. The following table will enable you to figure the quantities of each material needed for any job, by adding together or multiplying the quantities in the table corresponding to the volumes in the first columns. The first column shows the quantity of concrete. The other five divisions show the different mixtures and quantities of materials under each mixture needed to produce quantity of concrete given in first section.

Cubic feet of Concrete	1 : 1½ : 3 Mixture			1 : 2 : 3 Mixture			1 : 2 : 4 Mixture			1 : 2½ : 5 Mixture			1 : 3 : 6 Mixture		
	Bags Cement	Cubic feet Sand	Cubic feet Stone	Bags Cement	Cubic feet Sand	Cubic feet Stone	Bags Cement	Cubic feet Sand	Cubic feet Stone	Bags Cement	Cubic feet Sand	Cubic feet Stone	Bags Cement	Cubic feet Sand	Cubic feet Stone
100	28	42	84	25 4/5	51 3/5	77 2/5	22	44	88	18	45	90	16	48	96
90	25 1/5	37 4/5	75 3/5	23 1/5	46 2/5	69 3/5	19 4/5	39 3/5	79 1/5	16 1/5	40 1/2	81	14 2/5	43 1/5	86 2/5
80	22 2/5	33 3/5	67 1/5	20 2/3	41 1/3	62	17 3/5	35 1/5	70 2/5	14 2/5	36	72	12 4/5	38 2/5	76 4/5
70	19 3/5	29 2/5	58 4/5	18	36	54	15 2/5	30 4/5	61 3/5	12 3/5	31 1/2	63	11 1/5	33 3/5	67 1/5
60	16 4/5	25 1/5	50 2/5	15 1/2	31	46 1/2	13 1/5	26 2/5	52 4/5	10 4/5	27	54	9 3/5	28 4/5	57 3/5
50	14	21	42	13	26	39	11	22	44	9	22 1/2	45	8	24	48
40	11 1/5	16 4/5	33 3/5	10 1/3	20 2/3	31	8 4/5	17 3/5	35 1/5	7 1/5	18	36	6 2/5	19 1/5	38 2/5
30	8 2/5	12 3/5	25 1/5	7 3/4	15 1/2	23 1/4	6 3/5	13 1/5	26 2/5	5 2/5	13 1/2	27	4 4/5	14 2/5	28 4/5
20	5 3/5	8 2/5	16 4/5	5 1/5	10 2/5	15 3/5	4 2/5	8 4/5	17 3/5	3 3/5	9	18	3 1/5	9 3/5	19 1/5
10	2 4/5	4 1/5	8 2/5	2 3/5	5 1/5	7 4/5	2 1/5	4 2/5	8 4/5	1 4/5	4 1/2	9	1 3/5	4 4/5	9 3/5
9	2 1/2	3 4/5	7 3/5	2 1/3	4 2/3	7	2	4	8	1 3/5	4	8	1 1/2	4 1/3	8 2/3
8	2 1/4	3 3/8	6 3/4	2	4 1/6	6 1/4	1 3/4	3 1/2	7	1 2/5	3 3/5	7 1/5	1 1/4	3 7/8	7 3/4
7	2	3	6	1 4/5	3 1/2	5 2/5	1 1/2	3	6	1 1/4	3 1/8	6 1/4	1 1/8	3 3/8	6 3/4
6	1 2/3	2 1/2	5	1 3/5	3 1/5	4 3/5	1 1/3	2 2/3	5 1/3	1 1/10	2 3/4	5 1/2	1	3	6
5	1 2/5	2 1/10	4 1/5	1 1/3	2 2/3	4	1 1/10	2 1/5	4 2/5	9/10	2 1/4	4 1/2	4/5	2 2/5	4 4/5
4	1 1/8	1 3/4	3 3/8	1	2	3 1/5	7/8	1 3/4	3 1/2	7/10	1 4/5	3 3/5	5/8	2	4
3	4/5	1 1/4	2 1/2	3/4	1 1/2	2 1/3	2/3	1 1/3	2 2/3	1/2	1 1/3	2 2/3	1/2	1 1/2	3
2	9/16	7/8	1 11/16	1/2	1	1 1/2	7/16	7/8	1 3/4	1/3	9/10	1 4/5	5/16	1	2
1	9/32	7/16	7/8	1/4	1/2	3/4	7/32	7/16	7/8	1/5	1/20	1	5/32	1/2	1

This table will help you estimate correctly.

37. Example: If you want to know materials for 291 cubic feet of 1:2:4 mixture, look in the columns headed "1:2:4 mixture," copy out the figures for 100 cubic feet and multiply them by two, to make 200. You will have *44 bags cement, 88 cubic feet of sand and 176 of stone.* Then look under the same head, opposite 90 cubic feet: *19 4/5 bags cement, 39 3/5 cubic feet sand and 79 1/5 cubic feet stone.* Then look opposite 1 cubic foot and you find *7/32 bag cement, 7/16 cubic foot sand and 7/8 cubic foot sand and gravel.* Add these three and you find that for 291 cubic feet of concrete in 1:2:4 mixture, you will need 64 bags cement, 128 cubic feet sand and 256 cubic feet stone or gravel.

38. To figure out how many cubic feet of concrete there are in your job, write down the dimensions all in feet or fractions of feet so that your result will be in *cubic feet.* To find the cubic feet in a pavement 30 feet long, 4 feet wide and 4 inches thick, write the last dimension as feet (like the others) calling it 4/12 or 1/3 foot. Then multiply 30 by 4 by 1/3 and the answer will be 40 cubic feet. Look in the table under the mixture that you are going to use—opposite 40. Take the quantities there for your job.

39. For a wall or a slab or a roof, you will find it easy to calculate the total cubic feet of concrete if you will just remember that you must multiply together the three different dimensions—all expressed in feet or fractions of feet.

40. For more difficult buildings, take each part by itself—floor, wall, roof or whatever it is.

41. For complicated jobs, be careful not to count corners twice—on walls for instance. If you are building a trough, 12 feet long, 6 feet wide, walls 6 inches thick and 48 inches high, the two long walls will be 12 feet long, 4 feet high and 6 inches thick, but the other two walls will be only 5 feet long, 4 feet high and 6 inches thick,—because the 6-inch thickness comes off the end of each of the short walls at each end.

42. If you are building a square tank or a room or anything hollow for which the proportioning of materials is the same in all its parts—figure on the whole thing as if it were solid and then subtract the cubic contents of the hollow part in the center. For instance, you could find out the number of cubic feet of concrete needed for a tank 10 feet long and 10 feet wide and 8 feet high with walls, floor and roof all 6 inches thick, by calculating first the contents of the whole thing as if it were solid. That would be 10 times 10 times 8, or 800 cubic feet. Then figure the contents of the hollow inside. Allowing for the 6-inch walls, the inside measurements will be 9 feet long, 9 feet wide and 7 feet high. So the contents of the hollow part will be 9 times 9 times 7, or 567 cubic feet. The number of cubic feet in the walls, floor and roof will be the difference between 800 and 567, or 233 cubic feet.

43. To calculate for anything circular there is one rule to remember: the area of a circle is found by multiplying the diameter by the diameter, then multiplying the result by 3 1/7 and dividing by 4. So that a circular slab of concrete 7 feet in diameter would have an area 7 times 7 times 3 1/7, divided by 4—that is 38 1/2 square feet. Multiply this area by the thickness in feet or fraction of a foot, and you have the number of cubic feet in the slab. If this slab is 6 inches thick, the number of cubic feet in it will be 38 1/2 multiplied by 1/2—or 19 1/4.

44. If you are building a circular tank, figure the total contents as if it were solid right through. Then calculate the contents of the hollow space that is *not* to be filled with concrete and subtract this from the first total.

Note.—The mortar and concrete tables below give the cubic foot quantities of mortar and concrete respectively resulting from each of the mixtures shown. See Fig. 6 on page 7.

Amounts of mortar and concrete—different mixtures

Mortar

Mixture		*Volume of Mortar*
Cement	*Sand*	
1 bag	2 cubic feet	make 2 1/10 cubic feet
1 "	2 1/2 " "	" 2 1/2 " "
1 "	3 " "	" 2 4/5 " "

Concrete

Mixture			*Volume of Concrete*
Cement	*Sand*	*Gravel or Stone*	
1 bag	1 1/2 cubic feet	3 cubic feet	make 3 1/2 cubic feet
1 "	2 " "	3 " "	" 3 9/10 " "
1 "	2 " "	4 " "	" 4 1/2 " "
1 "	2 1/2 " "	5 " "	" 5 2/5 " "
1 "	3 " "	5 " "	" 5 4/5 " "

III. Mixing concrete

45. Concrete should be mixed near the place where it is used, because it begins to "set" almost as soon as you have mixed it. Mixing can be done either by hand or machine.

46. When you mix the concrete for the first batch, determine just how much water produces the required consistency and then use the same quantity, carefully measured, for other batches of the same size for the same job. Try to get a "quaky" or jelly-like consistence. A mixture of this consistency can be made to settle into place evenly.

47. If too much water is used the mixture will be thin, sloppy or soupy—instead of jelly-like—and then the mortar is likely to separate from the broken stone. Too little water will not allow the concrete to attain its full strength. Use enough water to produce a quaky consistency.

48. The three grades of consistency used are:

1. *Very wet consistency*—not to be used except for very thin walls or sections.

2. *Medium consistency*—quaky or jelly-like. The best consistency to use for ordinary work.

3. *Dry consistency*—like damp earth. This consistency must be thoroughly tamped or packed when deposited. Not recommended for ordinary work.

Fig. 7—Three typical consistencies of concrete mixture when poured. A guide for mixing concrete for different kinds of work.

Hand mixing

49. A satisfactory platform can be made for mixing ordinary quantities of cement by laying boards together on the ground. It will be better to have the ground smooth underneath so that the boards will fit pretty close together. When you just lay boards down on the ground this way, you will lose some cement in the first batch you mix, but after that the loss will be very small. If you want to go to the expense, you can nail a platform together, using inch boards placed on 2-by-4-inch stringers spaced 2 feet apart, making the platform as tight as possible. If you want to make a really watertight platform, use two layers of boards, laying one layer crossways of the other. If the boards are smooth on top, shoveling and turning will be easier.

50. In doing the actual mixing, you will find the following method most satisfactory:

A. Measure all materials accurately to get correct proportions. Make a measuring box to hold a cubic foot—a bottomless box measuring one foot each way (inside measurement). Put handles on the side, so that you can raise the box easily.

B. Wheel the sand to the mixing board, measure it and spread it about 4 inches deep on the board.

C. Empty on the sand the correct amount of cement, according to the mixture desired—see Proportioning on page 7. Spread the cement evenly over the sand.

How to build walks—see page 28.

D. Turn dry sand and cement over and over with a shovel or hoe until they are thoroughly mixed.

E. Spread out the mixture and empty on it the proper amount of coarse aggregate carefully measured. Mix this thoroughly.

F. Add three-quarters of the required amount of water—say, about three-quarters of a gallon to each cubic foot of concrete. Be careful to add the water slowly and evenly, mixing the whole mass at the same time.

G. Add more water wherever dry spots appear, until the whole mass has been turned or shoveled over three or four times.

H. Then shovel the mixture into a compact mass and wheel away.

Machine mixing

51. Mixing by machinery is more economical than doing it by hand on large jobs. It will be an actual saving for you to buy or hire a small mixer if you are planning to do any great amount of concrete construction.

There are many types of power-operated concrete mixers on the market—small ones with gasoline engines and large, self-propelling machines. Don't think of buying anything but a batch mixer that is, one with a revolving drum in which all the materials are put together and which revolves until the mixing is completed. You must be careful to leave the material in the drum long enough to assure thorough mixing—at least three minutes after all the materials are in the drum. It is just as important to be careful and accurate about the amount of water in machine mixing as in hand mixing.

IV. Placing and depositing of concrete

Fig. 8—Tamper—wooden handle with metal block at end—to pack concrete into place

52. After the concrete has been mixed, it is in plastic form and must be placed in forms or moulds to shape it in the required form. The construction of forms for concrete is explained later in this book.

53. Concrete must be placed *as soon as it is thoroughly mixed*, because it begins to set very soon.

54. Methods of placing vary with working conditions and the nature of the construction, but these are rules that you will find useful for nearly every sort of construction:

A. Place concrete in layers about 6 inches thick.

B. Pack it down lightly with a tamper or rammer. See Fig. 8. Do this until water shows on top of the concrete and mortar covers all the stones from sight. This makes the mixture dense.

C. If you want your work to be smooth on the surface, as on an exposed wall, work a spade back and forth and up and down between the concrete and the form on the side where the finished concrete will be exposed to view. This brings the coating of mortar next to the form. Where a spade can't be used because there is not room, substitute a thin wooden paddle, made from a board that is 1 inch by 4 inches, sharpened to a chisel edge on one side of the end. Keep the flat side of the paddle next to the form, and the sharpened side turned in.

The drier the mixture, the more important are tamping and spading.

Protection of concrete

55. If the forms are removed as soon as the green concrete will sustain itself, where the surface of the concrete is exposed to the elements the concrete must be protected from the drying action of the sun and hot winds.

Concrete should set five or six days before being exposed and during this interval you should sprinkle it with water every morning and afternoon, to keep the surface of the concrete from drying out faster than the centre.

Protect the concrete, if the surface is exposed, with old burlap hung an inch or so from the surface, and keep this cover in a damp or moist condition all the time.

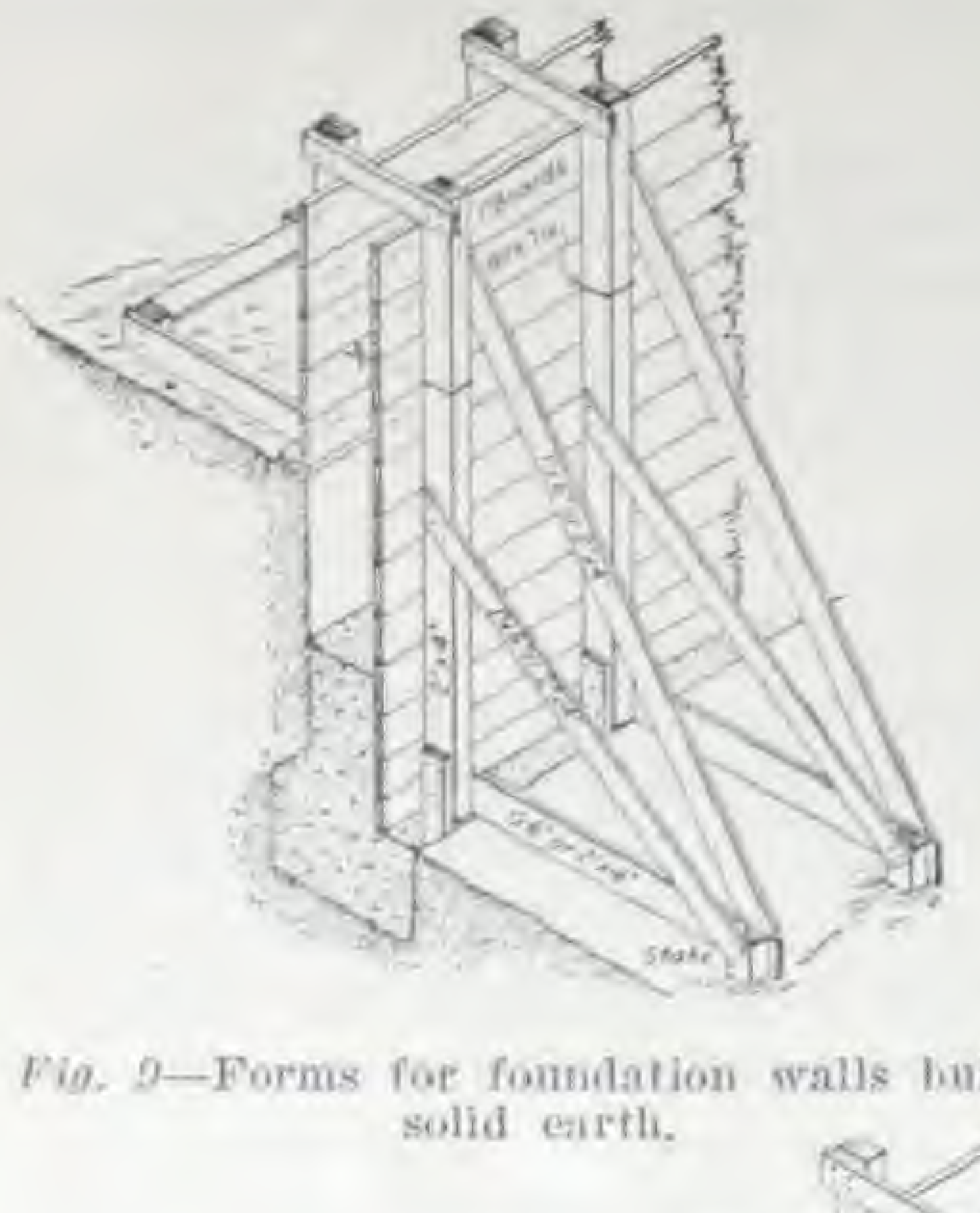


Fig. 9—Forms for foundation walls built in solid earth.

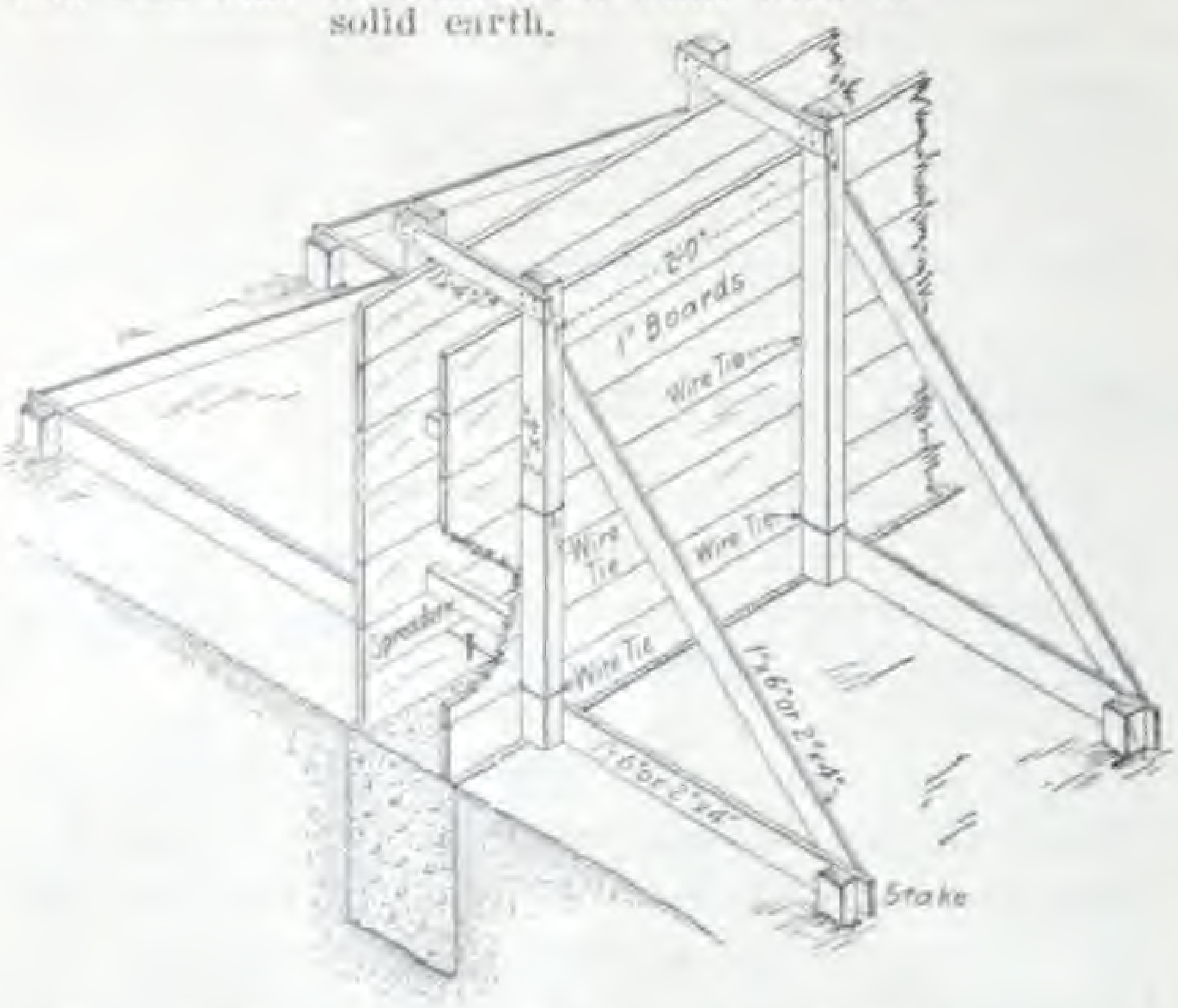


Fig. 10—Form for wall above foundation.

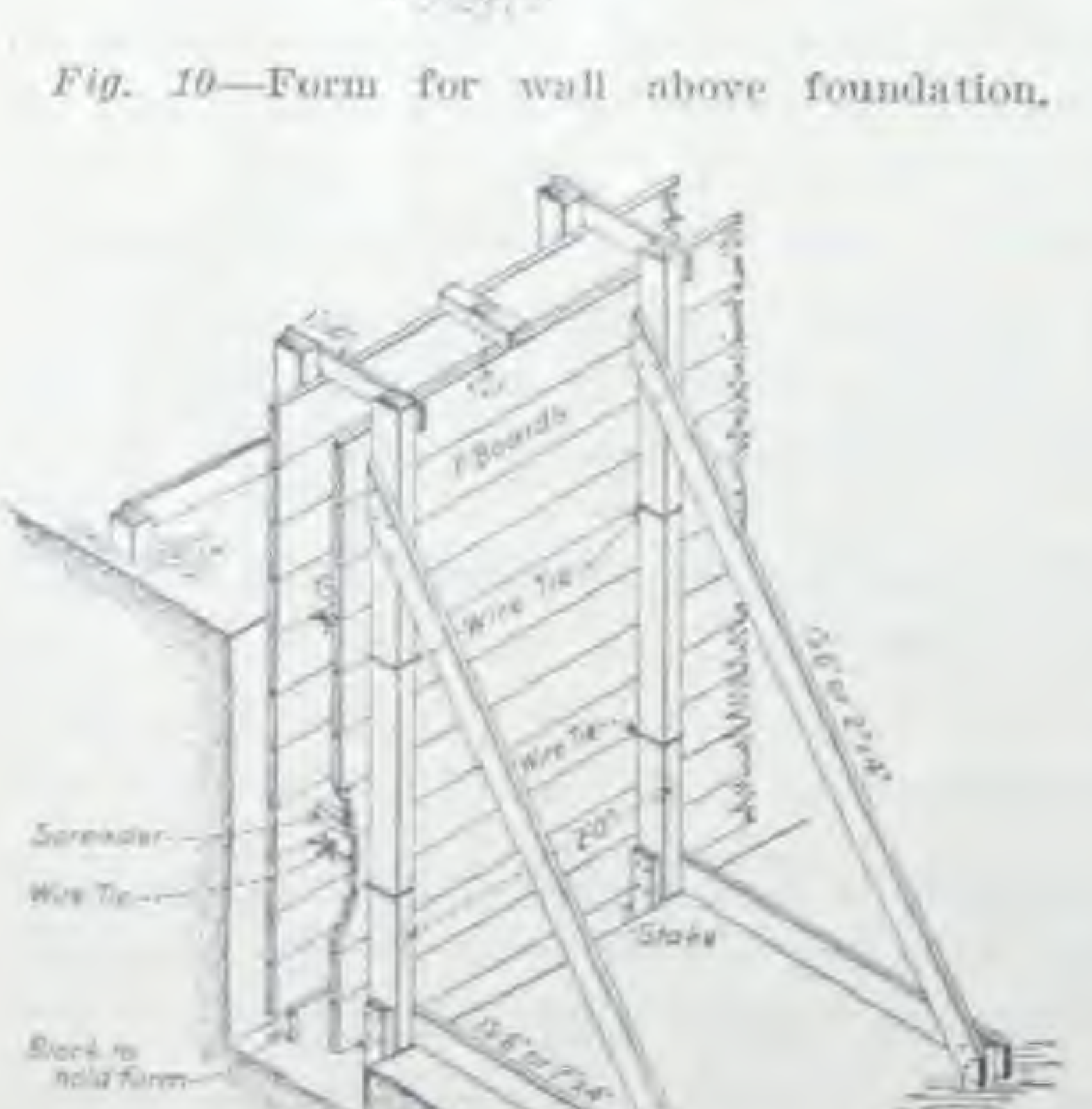


Fig. 11—Forms for wall in soft earth.

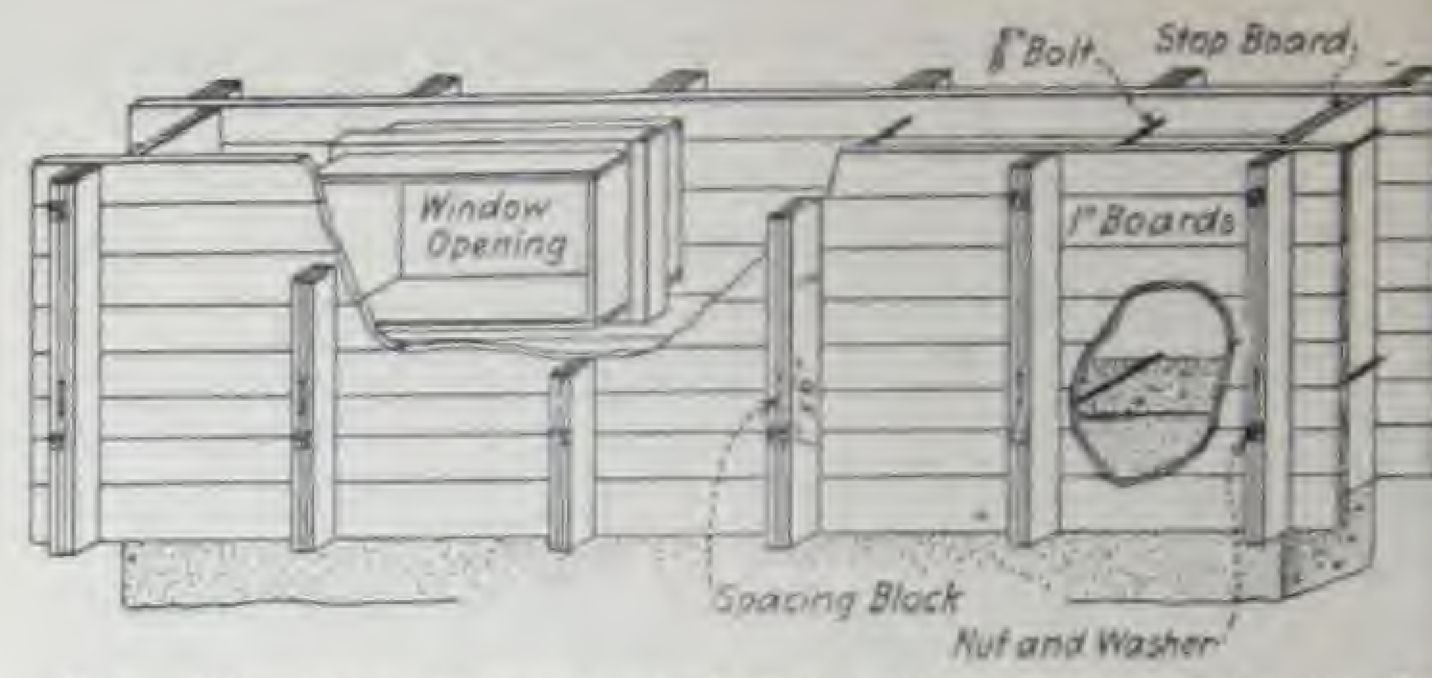


Fig. 12—Arrangement of form when window is to be inserted—Sectional form to be raised as wall is built up and used over and over.

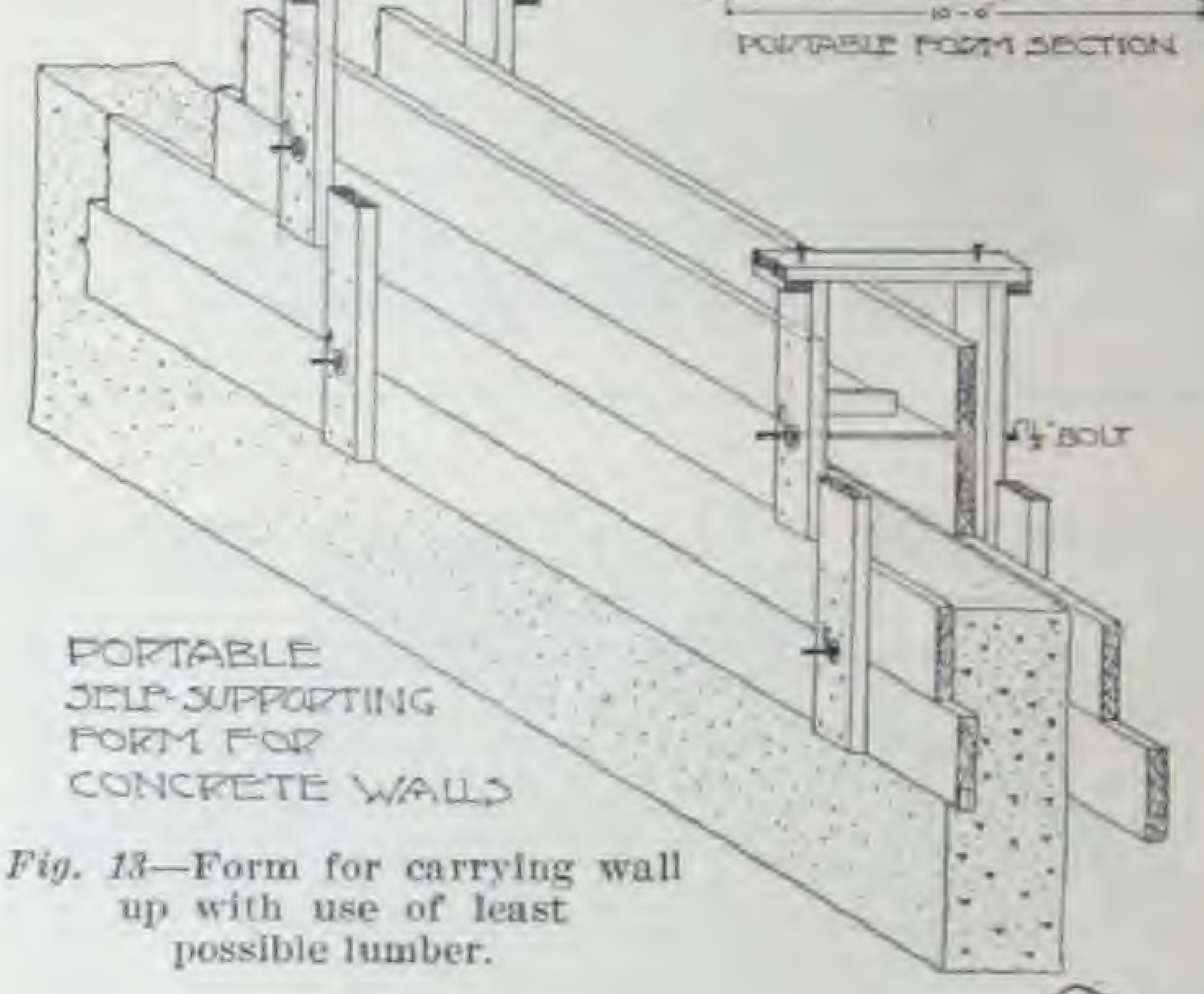


Fig. 13—Form for carrying wall up with use of least possible lumber.

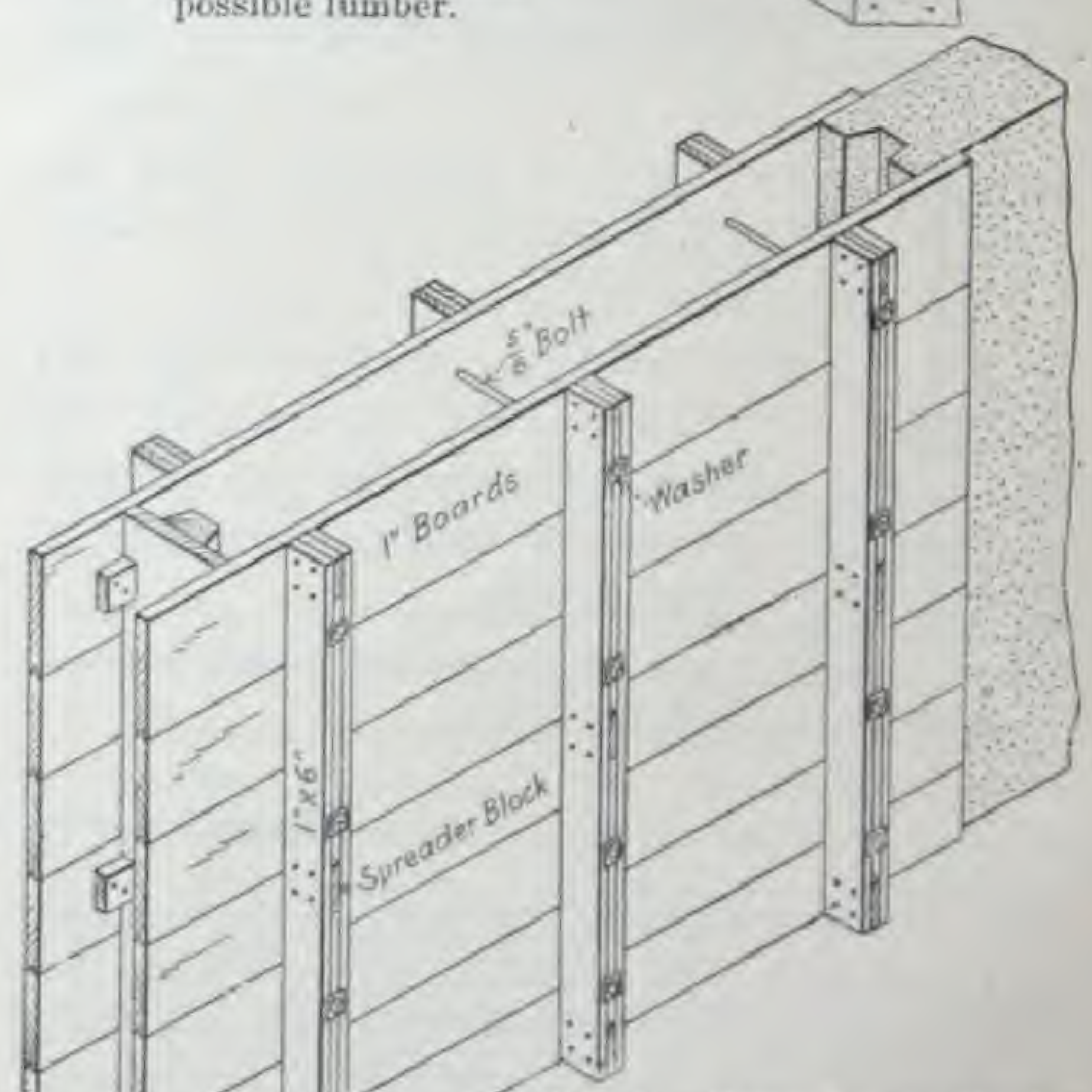


Fig. 14—Form for continuing wall lengthwise with notch in completed part to make a bond with newly deposited concrete.

How to build foundations—see page 20.

V. Forms for concrete—General information

56. Before it hardens, concrete will take the shape of anything it is poured into. The forms that shape the concrete have to be strongly made because plastic concrete is very heavy.

57. Green lumber should be used. Seasoned wood will swell and warp from the moisture in the concrete. Planed lumber is more easily cleaned and the concrete does not stick to it so easily. If it is possible, use lumber that is dressed or planed along both edges, and make the form as tight as you can. If the forms are soaked with water before the concrete is poured in, there will be very little leaking of the mixture.

58. Where you want to make an exceptionally nice job, if you can get tongued and grooved boards or beveled boards to use in making your forms, you will get a much smoother finish.

59. Grease the forms with soap, linseed oil or crude oil to keep the concrete from sticking to the lumber. This must be done even if the lumber is planed.

60. Be sure to get forms absolutely vertical —especially forms for walls or piers. Use a spirit level or a plumb bob.

How long should forms be left in place?

61. The length of time you will need to leave forms in place depends on what you are building.

62. For small construction work where the concrete bears no weight, the forms may be removed as soon as the concrete will bear its own weight—that is, some time between 12 and 48 hours after the concrete has been placed.

63. Where the concrete must resist the pressure of the earth or water—as in retaining walls or dams—the forms should be left in place until the concrete has developed nearly its final strength (this may be as long as three or four weeks, if the weather is damp or cold, or anything else prevents quick curing).

Foundation and wall forms

64. No forms are needed for small foundations if the soil is firm. Simply dig a trench the exact size; moisten its sides and bottom thoroughly to prevent the soil absorbing moisture from the concrete; and fill the trench with the concrete.

65. Figure 9 shows the construction of a form for a foundation wall where the soil is firm enough to act as a form for one side of the wall. The wooden form, for the other side of the wall, is held up on stakes to permit the concrete to run out a little under the form and make a footing or broader base for the wall.

66. For walls above ground, forms are required on both sides. The heavy concrete is likely to bulge these forms or force them apart. Therefore, the forms should be braced strongly against the ground; or the two sides of the form may be held together by wires or bolts; or better yet, as it prevents bulging or spreading and keeps the two forms exactly the right distance apart, the braces and the bolts (or wires are used together).

67. Figure 10 shows the method of bracing wall forms built on a footing already in place. Wires around the studding hold the forms together, and can be tightened to make the distance between the forms the exact thickness of the wall. Pieces of wood, called spreaders, each cut to a length equalling the thickness of the wall, are inserted to keep the walls the right width. They are knocked out as the concrete is poured.

68. Figure 11 shows foundation wall forms for both sides. The one next to the earth is supported on small blocks so that the concrete can flow out and make a broader base or footing. The inside form rests on the earth. This diagram shows how bolts can be placed in the top of the wall to fasten sills to the foundation.

69. Figure 12 shows forms for walls that can be used over again several times. Slotted uprights are made of boards 1 inch thick and 4 inches wide, separated by small blocks. Through these uprights, to hold the forms together, there are bolts, which must

See page 74 for heavy retaining walls.

be thoroughly greased so they can be removed easily from the concrete. The same type of form is used for *walls built in successive layers.* The method of operation is shown in Figure 13.

70. A *long wall* is most easily built in sections, the same forms being used several times. As soon as the first section has had time to set, the forms can be moved along and the next section poured. One end of the forms fits over the concrete already in place. The other end is closed by a vertical board with a wedge-shaped block on the inside (see Figure 14) to make a recess at the end of one section so that the new concrete of the next section will make a tight joint with the old concrete of this section and key in with it.

Forms for piers and columns

71. Forms for *columns* and *posts* which are filled with concrete in an upright position are subject to much greater pressure near the lower part. They must, therefore, be built stronger at the bottom than at the top. The easiest way to do this is to put the yokes or clamps closer together near the bottom of the form. For column forms the boards should be placed vertically; they should be tongued and grooved so that the pressure of the concrete will not force water and cement between the boards.

72. A form made on the plan of Figure 15, measuring inside 10 or 12 inches on each side at the top and a little more at the bottom—being sloped so that it can be lifted off the concrete, is a very useful form to make and keep around. With such a form you can do a great deal of work at odd times, when you need two or three piers, or even more, to use as a foundation for some building. The top level of the pier can be regulated by putting blocks under the handles of the form. By digging the hole for the base of the pier about 6 to 8 inches bigger each way than the form, you will get a very substantial pier. The figure explains itself, and you can readily see how you can make very frequent use of it.

73. For short *columns* or *piers* less than 5 feet high and not over 2 feet square, make the forms as shown in Figure 16.

74. Larger, heavier columns, because of the great weight of the concrete on the bottom, must have heavier forms, as shown in Figure 17. These heavier forms have yokes of 4-inch-by-4-inch material, held together by bolts, and side pieces held in position by wedges.

75. Where you build a column which carries no weight, you can usually take the forms off within 24 to 48 hours.

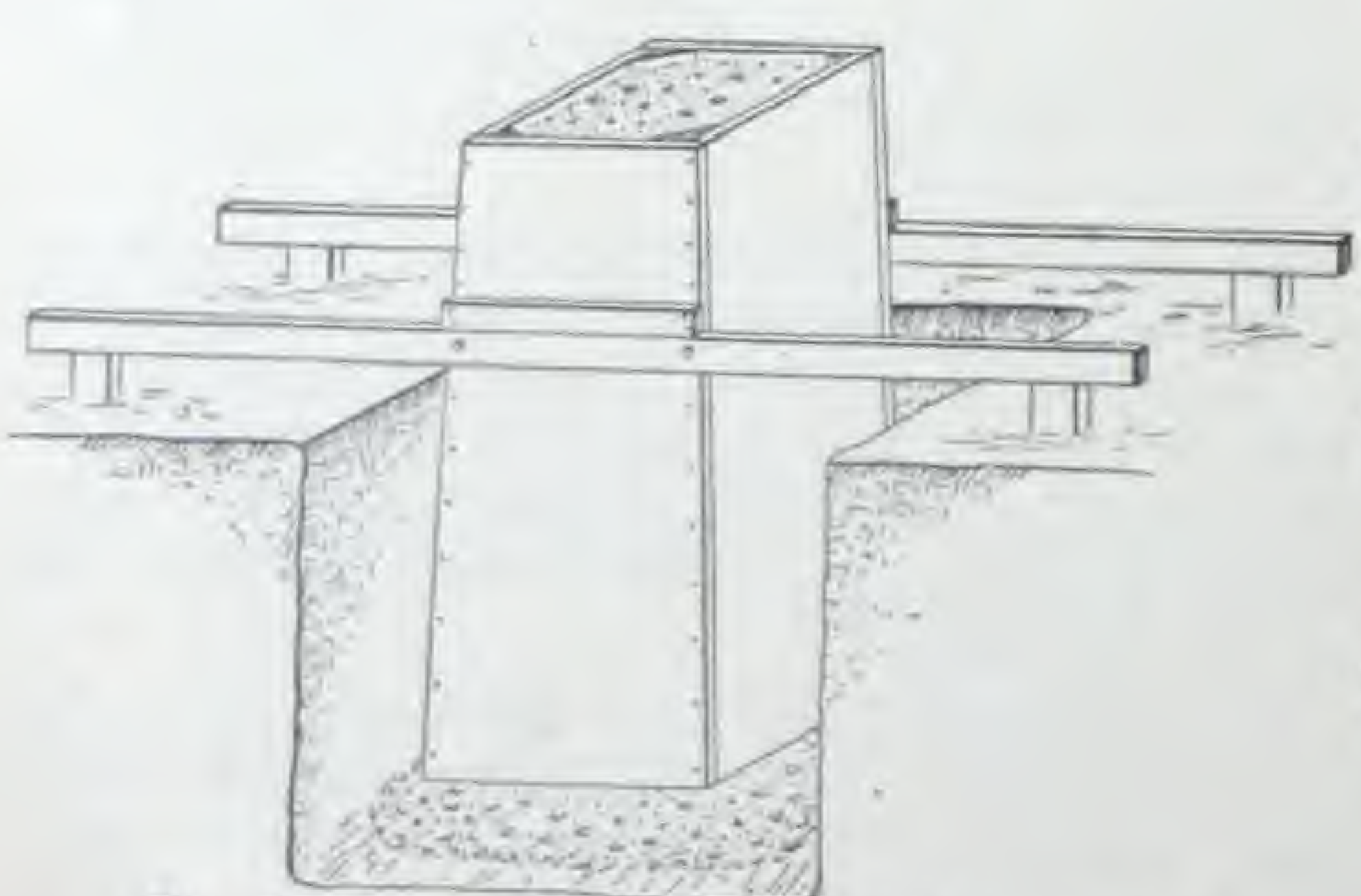


Fig. 15—Removable form for making piers or parts of foundation.

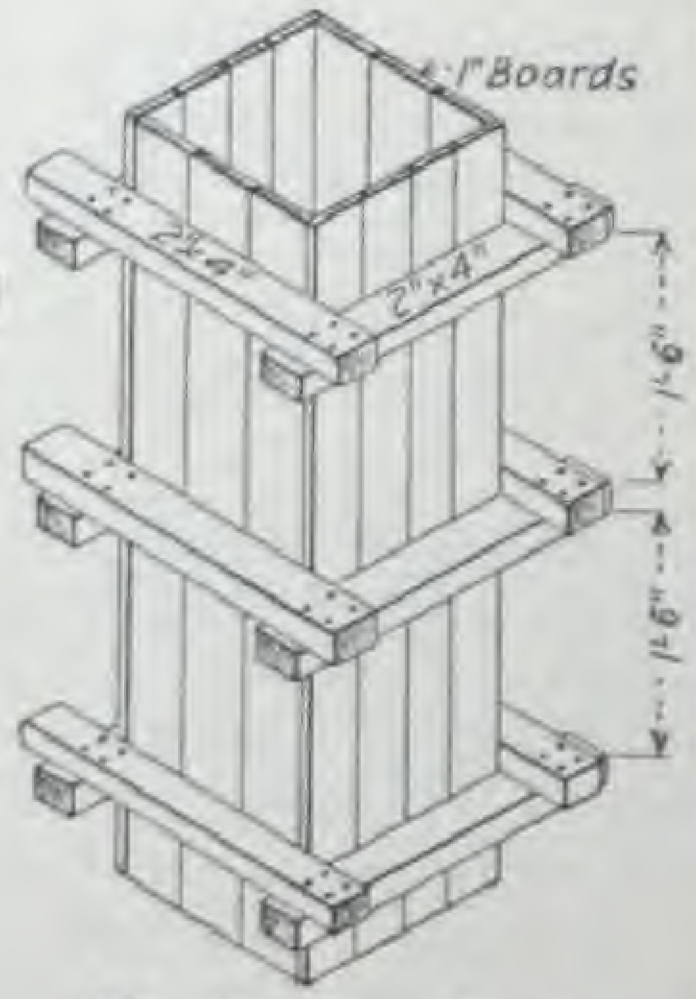


Fig. 16—Form for a short column.

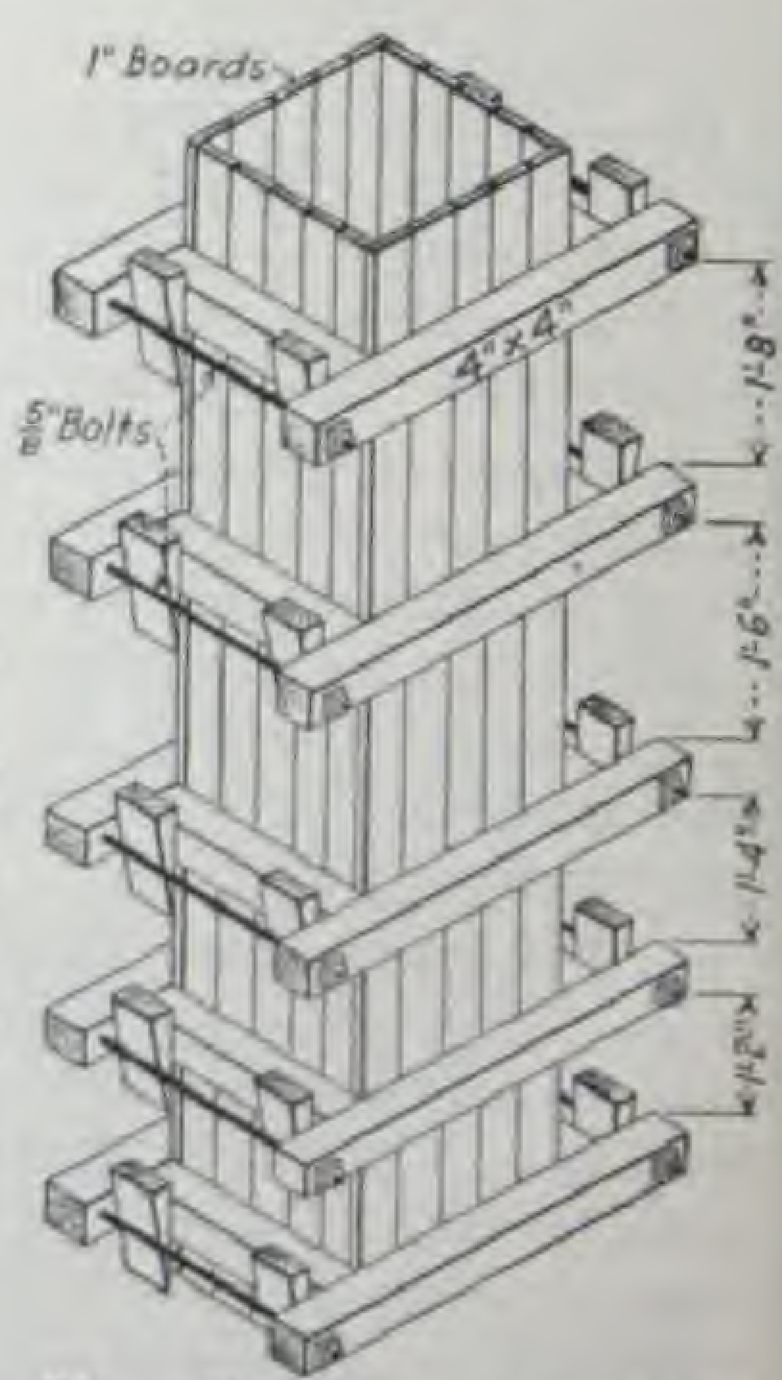


Fig. 17—Form for taller column which can be hoisted up and reset.

Build the corn crib on concrete piers—see page 50.

Forms for concrete roofs

76. Figure 18 shows forms for roofs, consisting of upright posts, each 4 inches square and not more than 4 feet apart, supporting 4-inch-by-6-inch crosspieces, which carry 2-by-4-inch or 3-by-4-inch stringers spaced not more than 2 feet apart. These stringers hold the 1-inch sheathing boards, running in the same direction as the crosspieces.

77. Forms for roofs should not be removed in less than three weeks' time. If the weather is cold or damp, you will find it better to leave the forms even longer than three weeks. It is very important that roofs have plenty of time to set before they are used.

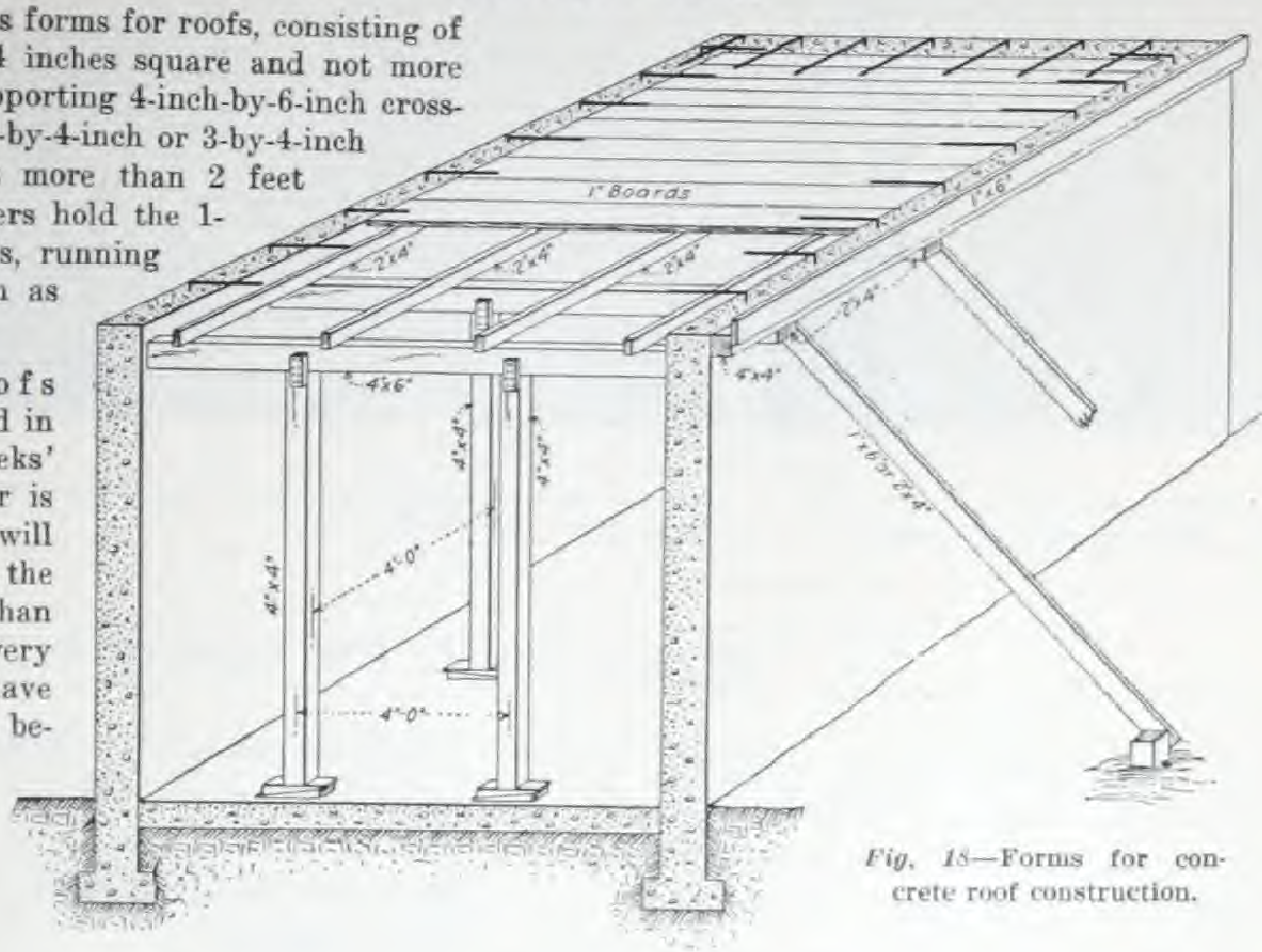


Fig. 18—Forms for concrete roof construction.

Forms for circular tanks, etc.

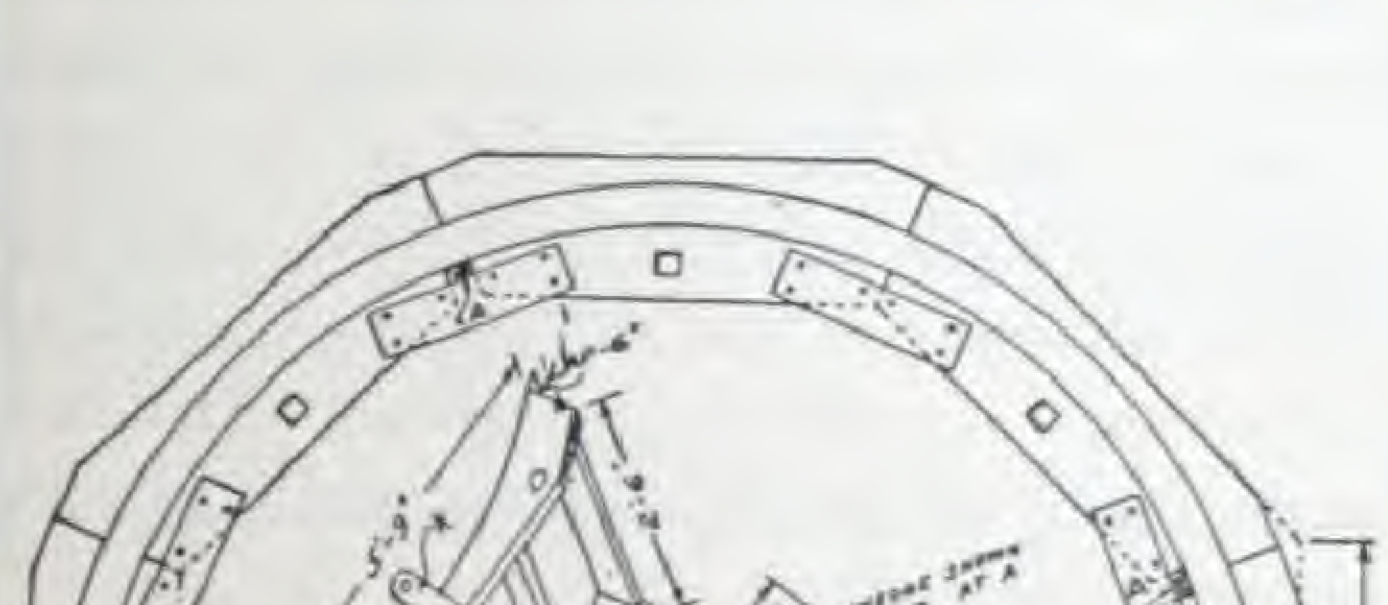


Fig. 19—Form for circular construction.

78. Circular forms—one for the outside and one for the inner wall—are built as shown in Figure 19.

79. Work on a level piece of ground or on the barn floor. Make a "compass-stick" of a light piece of wood which is a little longer than *one-half* the distance across the circular construction you plan. Bore holes in either end, so that the distance between the two is exactly one-half the diameter of the circle you plan. Through one of these holes drive a nail, through the other insert a lead pencil. Carrying the stick around with the pencil in place will mark the circle for the outer form. Then bore another hole for the pencil at a distance from the first the same as the thickness of the concrete to be—and using this in the same way you have the outline for the inside form.

80. Following these outlines, shape with a saw the parts of the forms shown in Figure 19.

81. For a tall tank, you should have two complete sets of forms. These are placed one on top of the other—see Figure 123, page 61. Both sets are then filled with concrete. When the concrete is sufficiently hard the lower set is removed and re-erected on top of the other. This section is then filled with concrete and the process is repeated. In this way the structure is made up in layers.

For the advantages of concrete silos—see page 51.

Fig. 20

Unfinished concrete surface showing laitance and form marks. Concrete surface finished by rubbing with carborundum block. Concrete surface with mortar finish.

VI. Surface finish for concrete

82. No special finish is necessary for most concrete construction, especially if proper care has been taken in all the steps and processes up to the point of finishing.

83. If the surface is to be exposed and you want it to present an attractive appearance, the concrete must be composed of good sound aggregate, very carefully mixed and quite as carefully deposited. Besides, the forms should be well constructed, for any slight imperfection or irregularity of the forms will shape itself into the molded concrete. Thorough spading of the concrete as soon as it is placed prevents voids or pockets of rough aggregate on the outside surface. By "spading" is meant working a spade back and forth and up and down between the concrete and the form on the side where the finished concrete will be exposed to view. This brings the mortar to the front next the form, as described in paragraph 54-C on page 11.

84. Observe carefully the following for concrete having exposed surface:

Careful selection of aggregates
Accurate proportioning and thorough mixing
Careful deposition in place
Well constructed forms
Spading the concrete

But no matter how well you construct your forms and spade the mixture, the concrete will show board marks. These are not always removed, but it is easy to get rid of them, if desired, by rubbing the surface, as explained in the next paragraph.

85. *Rubbed or floated finish.* As soon as the forms are removed, rub the concrete with a cement mortar brick (a brick made of 1 part of cement and 2 parts of sand) or with a carborundum block. Keep the surface thoroughly flushed with water and rub it until the pores and little roughnesses of the surface are eradicated and the color is uniform throughout. This is a simple, quick method of finishing and it gives a permanent, satisfactory surface.

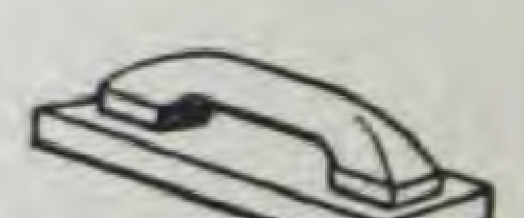


Fig. 21 — Wooden float for finishing concrete surface.

86. *Mortar finish.* Facing concrete with a coat of mortar plaster is often a troublesome undertaking because it is difficult to obtain a satisfactory bond—that is, a strong enough cohesion — between the concrete mass and the surfacing mortar. (For bonding surface mortar coats, see next page.) The mortar should be applied in as thin a layer as possible. The proper proportions are 1 part Portland cement and 2 parts sand.

VII. Bonding mortar or concrete to concrete already set

87. Bonding concrete surfaces—that is getting them to bind together well, making the bond between them strong—must be very carefully done on any sort of job. Getting newly mixed or green concrete to bond with concrete that has already set is often very difficult—but it can be done, if you take the proper precautions in preparing the old concrete surface.

88. If you wish to place more concrete or a mortar facing on any previously set concrete surface, you must first remove from the surface the whitish scum which has no strength itself and to which fresh concrete will not adhere. This scum forms on all concrete surfaces which are exposed or against a form. It is made up of fine particles of cement, sand, and foreign matter, all brought to the surface by the water in the mixture.

89. One way to remove this scum is to take away the forms as soon as the concrete can bear its own weight, and then brush the scum off with a wire brush. If the concrete has set hard before the forms are removed, the surface scum cannot be removed unless the surface is roughened by stone picks or a cold chisel. Whatever the method of removing the surface scum, the aggregate of the concrete must be exposed, or the newly deposited concrete or mortar will not bond to the old.

90. *Mortar facing or surfacing.* If you are placing a mortar facing or surfacing on a concrete surface, drench the wall thoroughly with water not more than 30 minutes before the application of the mortar, and brush the surface with a thin cream made of cement and water. This cream should be mixed in small batches as the work progresses and should be used within 30 minutes after it has been mixed, because it loses its strength after that time.

91. Trowel the mortar facing on the surface after this preparation, and press the mortar firmly to a smooth uniform surface.

92. Sprinkle the mortar surface with water *twice* a day for about ten days. This is a positively *necessary* precaution, because facing cannot develop its full strength unless it has moisture supplied continuously throughout the time it is hardening. If drying is too rapid, there will be excessive shrinkage and the surface will check and show hair cracks.

93. Whenever it is possible, apply the mortar surfacing or wearing surface—as in sidewalks, floors, etc.—at the same time as the base or main mass of concrete. This gives far more satisfactory results and makes a perfectly solid mass—like one huge stone—in which there are no difficulties of bonding.

VIII. Waterproofing concrete

94. Concrete made from properly selected aggregates, combined with Atlas Cement in proper proportions, thoroughly mixed to the proper consistency, carefully placed, and well protected until it has had an opportunity to set, will be watertight under all ordinary conditions.

95. Investigations of the U. S. Government Bureau of Standards at Washington show that the use of waterproofing compounds, now on the market, will not make up for lean mixtures, poor materials, or poor workmanship, and that if the same care is taken in mixing, without these compounds, as is usually taken when the compounds are used, the resulting concrete will be waterproof under all ordinary conditions.

96. If you have trouble with concrete already placed which is not watertight, the reason is probably careless workmanship or poor design. Write about it to our Technical Department at either our New York or Chicago office. We will be glad to advise you what is the proper method to overcome the difficulty.

How to build dams—see page 67.

IX. Reinforcing concrete

97. When concrete is properly made it has the strength and characteristics of stone. Like stone, it will support heavy loads—as in foundations or in flat work resting directly on the ground, such as sidewalks; but concrete, like stone, will not stand much pulling apart or tension.

98. But when concrete is reinforced with steel rods, wire strands, or wire mesh, it has added strength, and will then stand some pulling apart or tension.

99. Where to put reinforcing, how much to use, and when it needs to be used, are all questions that involve highly technical points which need not be explained here in detail. The practical information that you need for each piece of construction you undertake will be given in this book in the next chapter under the section that describes the particular construction.

100. In most small work, such as sidewalks and cellar floors, reinforcement is not necessary. Reinforcement is needed in roofs or floor spans which are supported by walls or columns, in high walls, pillars and all kinds of posts. We are giving in another part of this book (see page 68) complete information on fence posts, and by following the instructions there you should have no difficulty in making satisfactory reinforced posts. For other work requiring reinforcing, except in very simple cases, you will probably find it safer and wiser to have a contractor or engineer advise you about reinforcing. The instructions for reinforcing which are given in the description of various kinds of construction in Chapter 3, should be followed very carefully, for it is very important to have reinforcing in exactly the right place and completely surrounded by the concrete.

Note—Should the instructions regarding reinforcing not be entirely clear or should you want information on a size or kind of structure not included herein, write our Technical Department, describing just what you want to build, the size you are planning, etc.—give us all the data you can, better too much than too little, so we can understand just what your problem is. We have experts who are thoroughly versed in the reinforcing of concrete, and they answer thousands of such questions every year. This service is free, of course, as explained on the opposite page.

X. Concrete in winter

101. If you have some indoor concrete work to do, such as cellar floors, barn floors under cover, etc., you can do it successfully in winter time if you take proper precautions to keep the concrete from freezing.

102. You can make fence posts, blocks, etc., *indoors* in the winter time very successfully, but outdoor work in concrete is not advisable after the temperature gets below 45 degrees. If you have to do some outside concrete work in cold weather, you must keep the concrete from freezing by heating the aggregates, using warm water, and properly covering the concrete until it gets so far along in setting that it will not freeze.

103. If you want any further information about concreting in cold weather, write to our Technical Department, telling just what the conditions are that you have to work against, and you will get just the help you need.

For concrete fence posts, see pages 68 to 73.

Further information for you

Good concrete is obtained by using good materials and by the proper mixing and handling of the materials. To all appearances, it is a simple operation, but like many other apparently simple operations it requires a certain amount of skill. The quality of the concrete, therefore, depends to a considerable extent upon the experience of the maker or builder or upon the instructions he follows.

You, of course, want the best job obtainable, whether a chicken house or a sidewalk. It is for the purpose of assisting you to secure such results that the Atlas Technical Department exists. This department will help you not only to obtain good concrete, but to build structures which you have not built before.

In compiling this book the Technical Department has given information in the preceding pages which will help you in the selection of good materials ; the proportioning, the mixing and the placing of concrete have all been taken up in detail so as to make them clear to you. In the next chapter the details peculiar to each structure are given. It is possible, however, that some questions may come to your mind as you read, no matter what your experience has been. You may want further information about some particular feature of the structure, such details as the quantities of materials, amount of reinforcement or other points. In such event we hope you will write us or have your dealer write us. You are under no obligation for this service.

The Atlas Portland Cement Company

New York *Chicago*

Chapter 3—What you can build in concrete

Foundations for large and small buildings

Foundations, to be satisfactory, must be strong, durable, and reasonable in cost. Concrete does not deteriorate and grows stronger with age. In every respect it is the ideal material for foundations.

Either solid concrete or concrete blocks may be used. In most cases, solid concrete is preferable because it is entirely in one piece, without joints, and is stronger. Where there is a possibility of ground water, solid concrete is far better because it is more water-tight.

Laying out foundations

At the corner of your proposed building where the ground is most nearly level drive a stake like "A" in Figure 22. Use a steel square to get the angle at the corner a true right angle. Carry a cord along one side of the square in the direction of one side of the building and as far as this side is to run. Put in stake "D" for the second corner, at the correct distance, and fasten the cord from "A" to "D." Go back to "A," and along the other side of the square carry a cord, in the direction of the second side, as far as the length of that side, and there put in stake "B." Fasten the cord from A to B. Take your square to B, lay one side along the cord A B and the other parallel to A D and in this direction carry a cord the distance of A D from B to C. Put in a stake at C. Carry a cord from C to D. Test your corner at C with the square. A second test will be to measure diagonally from A to C and from D to B; when these diagonals are exactly equal your four corners are square.

In squaring the corners and laying out the outside lines of the foundation, if the ground is not level, you will have to drive longer stakes in the low corners. If your "B" corner is in a low spot, drive a stake long enough so that the top of it is as high as the top of stake "A."

How to build in concrete

Forms: The construction of forms for foundations is described on page 13, paragraphs 64-70.

For ordinary trench walls, where there is good solid ground, you need build forms above ground only; and you can make the trench just the width of the wall desired. Put 2-by-10-inch planks flat on the ground along the edge to prevent the earth from being broken off and knocked into the excavation. Hang tarred paper or burlap on the side opposite that from which the concrete is dumped, so as to protect that side against crumbling by the concrete. Just before pouring the concrete, wet the earth to make it firmer.

For cellar or basement walls, if the ground is solid and firm, you need build forms for the inside only. If the ground is not sufficiently solid, then build forms for both sides, as described on page 13; see Fig. 11, page 12.

If your building is to have a frame superstructure with wooden floor, the foundation forms should be carried higher than the ground level, to provide for a floor a little distance above the ground. Build the forms of stock length lumber in sections, so that they can be used over and over again. Be sure that the concrete is sufficiently hard and strong before you remove the forms—see paragraphs 62-63, page 13. Do not fill in earth outside the walls for about 2 weeks after the concrete is poured, unless the inner forms are braced and left in place.

Excavation: You will have to carry your excavation for foundation walls, piers or any supports for buildings, below the frost line, that is, at least 2 feet deep in the southern states and 4 feet in the northern states. The depth of excavation will depend also on the character of the soil. You need a good, solid support. If the soil is spongy and soft just below the frost line, you will have to dig deeper, remove the soft material and then ram in cinders or gravel as a base. Where the soil is very soft, the bottom of the wall should be made wider than the wall itself. This provides a wider bearing base that gives sufficient stability in soils that otherwise would not bear the load of the wall and superstructure.

Construction: For average houses and small barns, 10 inches is thick enough. For larger houses and barns, foundations should be 12 inches thick. For small buildings like garages and poultry houses, 6 or 8 inches is enough.

Mixture should be 1 part Atlas Cement, 2½ parts sand, and 5 parts gravel or crushed stone. Where water is encountered in the excavation, make the mixture richer—as 1 part Atlas Cement, 2 parts sand, and 4 parts of gravel or crushed stone. This richer mixture makes a more dense concrete that will be waterproof if it is well tamped in the forms. See paragraphs 94-96, page 17.

Fastening building to foundation: If your building is to be wood on a concrete foundation, place bolts, head downward, at intervals in the concrete when you pour it. See Figure 24. Level off the concrete surface evenly and trowel it smooth. After the concrete has set and the forms are removed, put the wooden sill in place. It should have holes bored in it to conform to the bolts. Fasten it with nuts and washers on the upper side.

Amount Required: For every 100 cubic feet of foundation concrete, allow (for the 1:2½:5 mixture) 18 bags of Atlas Cement, 45 cubic feet of sand, and 90 cubic feet of gravel or stone as explained on page 9. For the 1:2:4 mixture, allow 22 bags of Atlas Cement, 44 cubic feet of sand, and 88 cubic feet of broken stone or gravel.

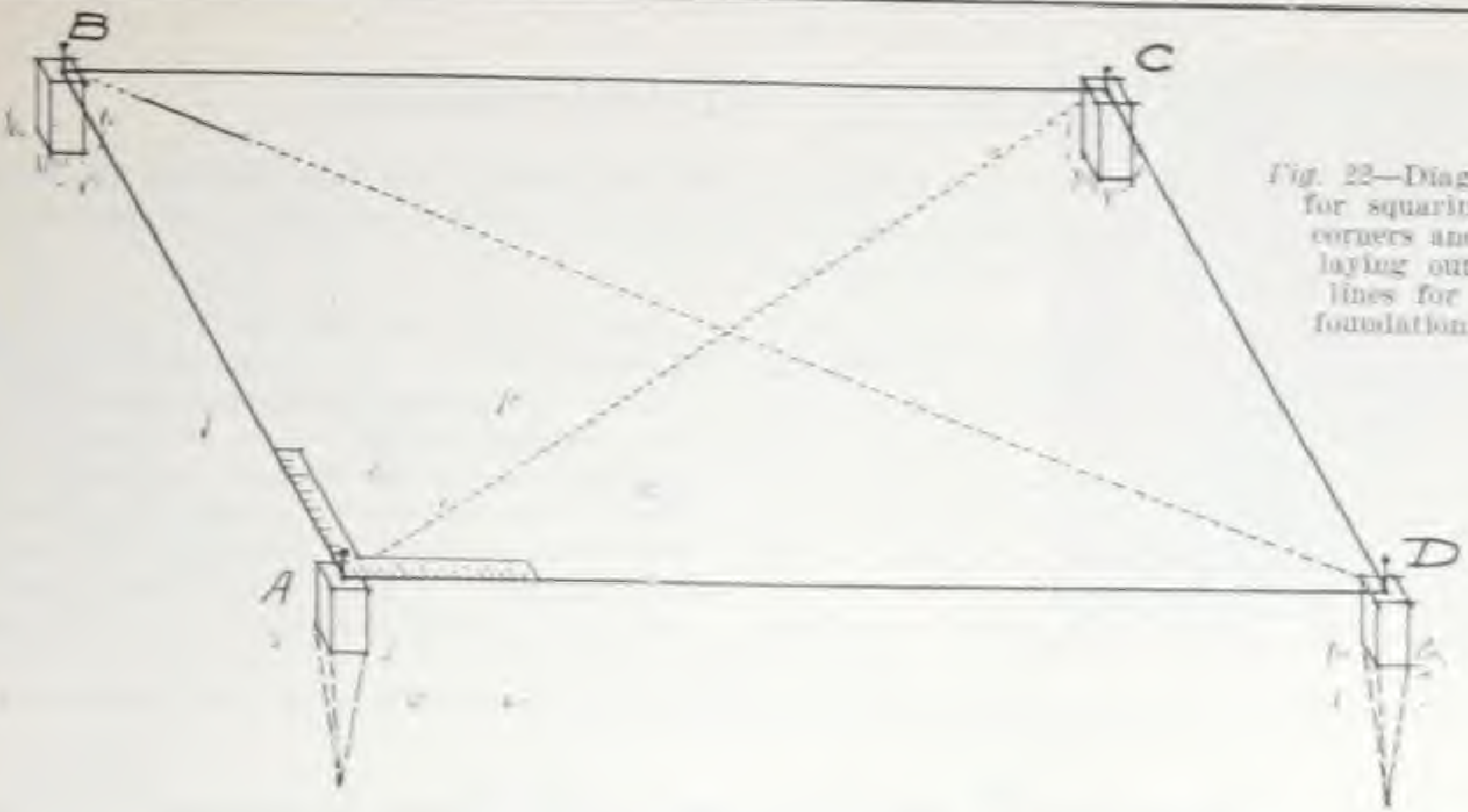


Fig. 22—Diagram for squaring corners and laying out lines for foundation.

Fig. 23—Partly finished concrete walls showing spaces for doors and forms for partition walls.

Fig. 24—Barn basement with projecting imbedded bolts for tying sills of superstructure to foundation.

Fig. 25—Small outbuilding, frame construction with concrete foundation and concrete walk.

Fig. 26.—Concrete basement for large barn used for stock.

See pages 12-13 for foundation forms.

Replacing old foundations

It is frequently necessary to replace wooden or stone foundations that have decayed or deteriorated. Concrete can be placed in small or large quantities and can be molded to any shape. It provides a strong and lasting foundation that never need be replaced.

Supports and Forms—If you have an old foundation in which the wood is rotting or the stones or bricks are loose, the faulty substructure should be removed and replaced with a strong durable foundation of concrete. Take great care in supporting the old building while you replace parts or sections of the old foundation. You can use jack screws or blocks of wood with wedges driven in to hold them in place. See Figure 32.

Construction—Use concrete composed of 1 part Atlas Cement, 2½ parts sand, and 5 parts gravel or crushed stone. Be sure to secure an even bearing for the sill and have the concrete well spaded on the outside surface. After about two weeks, under favorable weather conditions, the concrete should be strong enough to stand the weight of the building. Then lower the building, remove the props and fill with concrete the spaces where the props were. For each 100 cubic feet of concrete to be made, allow 18 bags Atlas Cement, 45 cubic feet sand, and 90 cubic feet stone or gravel.

Windmill and water tank foundations

Concrete is very well suited for the construction of windmill and water tank foundations. It is strong, does not rot or decay. Wooden foundations usually must be replaced every few years. Concrete foundations last forever. They can be easily and cheaply constructed.

Excavation—Excavate for the four corner foundation piers. Go deep enough to get below the frost line, and if the soil is not firm, fill with cinders or gravel well packed in place. Build forms so as to provide for four foundation piers, each 2½ feet square by 5 feet deep.

Fastening to Superstructure—Then construct a template to hold the bolts in place. See Figure 29. These bolts should be large enough to extend within 2 feet of the bottom and, of course, far enough above the top to provide proper fastening for the tower. For a steel structure the bolts must be long enough to extend through the steel base far enough for the nuts to be screwed on. For a wooden structure the bolts must be long enough to go through the wooden sill and allow washers below the nuts.

Mixture—The concrete should be 1 part Atlas, 2½ parts sand, and 5 parts of gravel or crushed stone. Pour the concrete 6 inches deep at a time and then pack it well in place—using the rammer shown in Figure 8, page 11. Be sure to allow the concrete to harden properly before it is used.

Quantities Required—Four piers of the dimensions given will require 23 bags Atlas Cement, 57 feet sand and 114 feet gravel or crushed stone. Two men can easily mix and place these piers in one day if materials are handy.

Engine foundations

Engines, cream separators, pumps, rams and other pieces of machinery require solid, durable foundations, free from vibration. No material is more suitable for this work than concrete. It is strong, rigid, and permanent.

Size—Engine foundations should be large or massive enough to hold the engine firmly—free from vibration. For ordinary gasoline farm engines a foundation 3 feet deep and a little larger than the engine base will be satisfactory.

Fastening to Superstructure—Figure 32 illustrates an engine foundation and shows how it should be constructed separate from the floor. It also shows the template used for holding bolts in position when the concrete is poured.

The bolt should extend at least 1 foot into the concrete base and have an iron washer at the lower end. Put a piece of pipe, at least twice the diameter of the bolt, over each bolt, to allow a slight adjustment of the bolts to the holes in the engine base. After the bolts are in the exact position desired, fill the spaces between them and the pipe with mortar of 1 part Atlas Cement and 1 part sand.

Mixture—Use for the foundation a mixture of 1 part Atlas Cement, 2½ parts sand, and 5 parts gravel. Let the concrete harden at least a week before the engine is placed on it. Don't begin using the engine until the concrete is two weeks old.

Quantities—For an engine base, 7½ feet by 4 feet by 3 feet deep, you will need (of the 1:2½:5 mixture) 16 bags Atlas Cement, 40 cubic feet sand and 80 cubic feet gravel or crushed stone; and building it will take about 9 hours' time of two men.

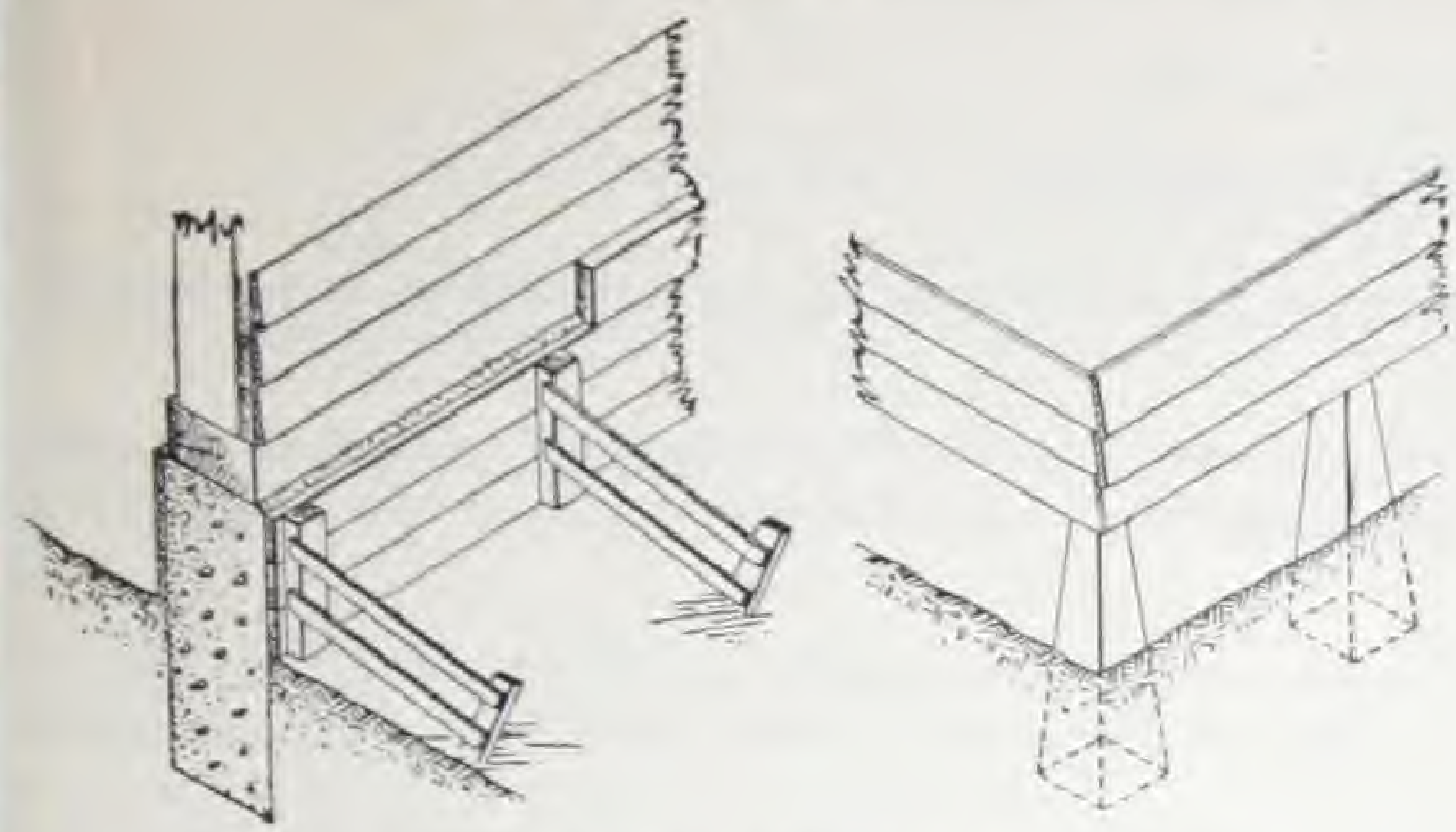


Fig. 27—Forms for solid foundation and for piers.

Fig. 28—Concrete barn foundation and shelter for small stock.

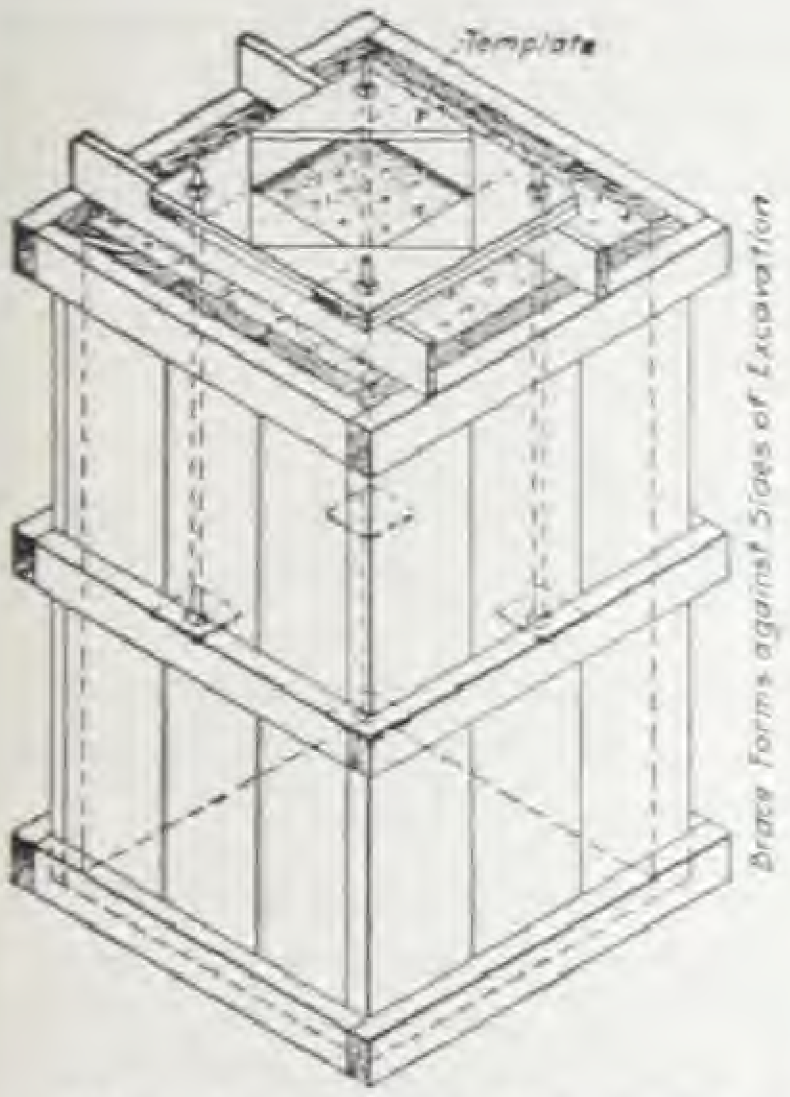


Fig. 29—Forms for piers to carry wind mill or water tank.

Fig. 30—Concrete piers to anchor windmill foundation.

Fig. 31—Piers for a water tank foundation.

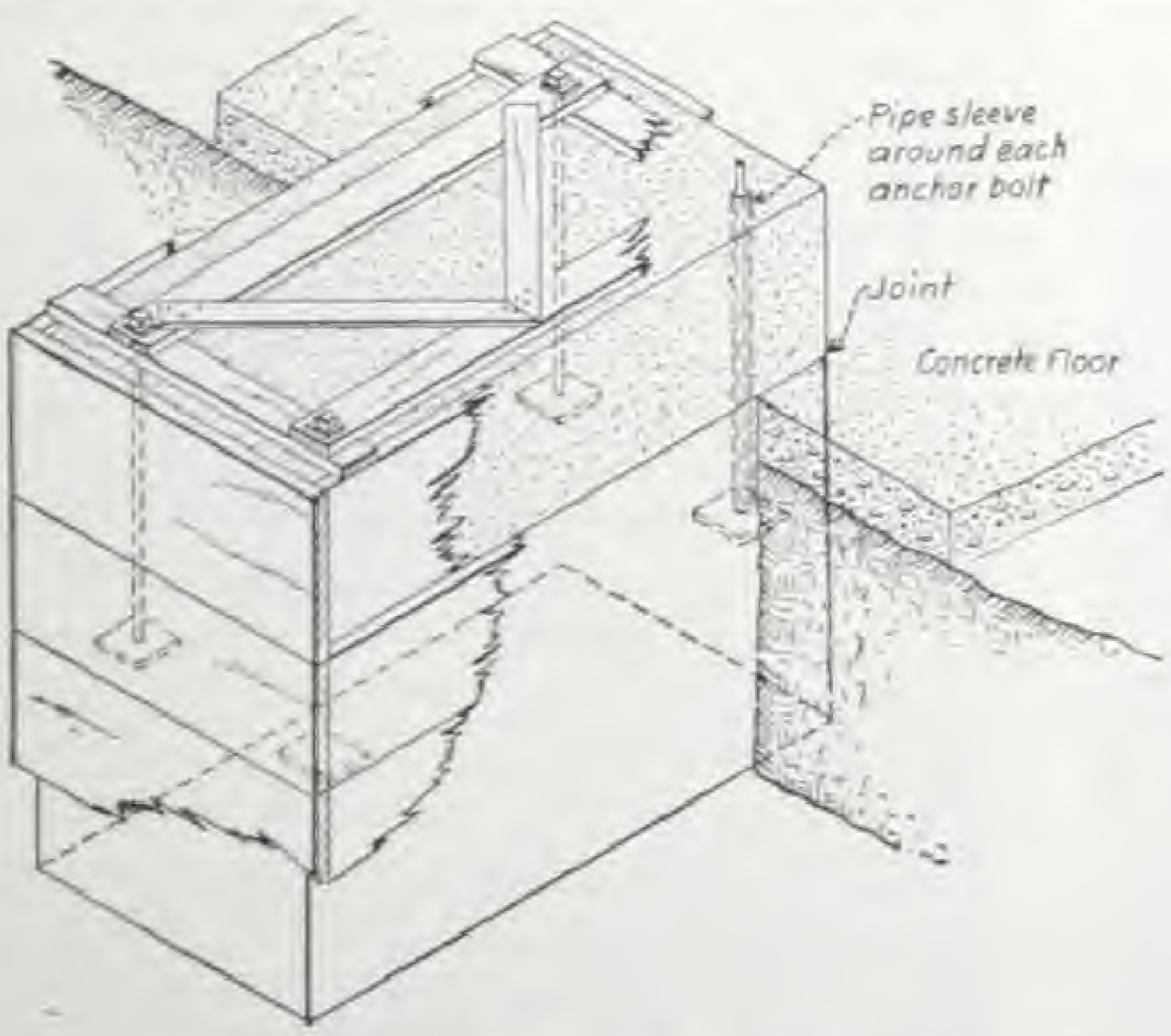


Fig. 32—Forms, bolts, foundations, etc., for concrete engine base.

Fig. 33—Concrete engine base—saving wear and tear on engine, floor and whole building.

Forms for foundations are described on page 13.

Root cellars and ice houses

You know how important it is to provide a proper place for storing roots to be used as winter feed and vegetables and fruits.

For a root cellar concrete is the most desirable material, because it is waterproof, will not rot, provides protection against rats and other rodents, and can easily be constructed with ventilator openings so that it will always be warm and dry.

For a small ice house on the farm, concrete is equally advantageous. As the construction of an ice house is practically the same as that of a root cellar, you can build one from the instructions given here for the other.

Location—The root cellar should be by itself, separate from any other building. The side that is entirely exposed should face south or southeast.

Types—Root cellars may be built with flat slab concrete roofs, arched roofs or pitched roofs. Sometimes they are built largely above the ground; sometimes entirely under ground and covered with earth. The most desirable arrangement is to have the cellar built half below and half above ground. See Figures 37 and 38. Figures 35 and 36 are of types that are equally adapted to small ice houses.

Construction of a concrete root cellar

The structure shown in Figure 34 can be built without any great difficulty. It is 20 feet long, 10 feet wide, and 7 feet high, inside measurements.

Excavation—First excavate 6 inches below the desired floor level of the root cellar, allowing an extra 10 inches at either end and sides for the width of the walls. At one end the earth should be dug out to a width of 4 feet and length of 9 feet, sloping up, allowing for a flight of steps. Each step is to have a rise of 7 inches and a tread of 10 inches. There should be a 3-foot landing at the bottom of the steps as shown in Figure 34. For information on building steps, see page 26.

Floors—In laying the floor it is better to make it one-course concrete, using 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. Make the floor 6 inches thick at the sides and 4½ inches at the center—to provide a slope from all sides to the center for drainage. The building of floors is described on pages 30 and following.

You can give the floor a smooth finish if you like by using a steel trowel, but when a wooden float is properly handled it will give you a floor that is smooth enough for all practical purposes.

Walls—The building of forms for walls has been explained in detail in the last paragraphs on page 13. If the soil is reasonably firm and hard, you will have to erect forms for the inside surface only, allowing the earth to take the place of the outside form.

Use a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

The concrete should be placed in layers 6 to 12 inches deep, and should be well puddled and spaded next to the forms. Carry on the work continuously, if possible; but if it is necessary to place concrete on successive days, clean off the surface of the concrete placed previously and treat it so as to provide a good bond between it and the new concrete; see what has been said on bonding, paragraphs 87-93, page 17.

Roof—The roof may be constructed of either wood or concrete. The wooden roof is simple of construction and will not be taken up here. The concrete roof is a permanent sanitary covering that will not rot or break down and is recommended for these reasons. The roof should have two ventilators as shown in Figure 34.

At least a week should elapse after the floor and walls have been poured before you begin the construction of the roof. This is the only part of the structure that need be reinforced. For reinforcing use ⅝-inch diameter round rods. Place them 1 inch from the bottom of the roof, and have them 6 inches apart, running crosswise, and 2 feet apart running the long way of the cellar. Use a 1:2:4 mixture for the concrete. Make the roof 8 inches thick at the center and 7 inches at the side to provide a slope. The forms and supports of the roof should remain in place at least three weeks under favorable conditions before removal. For the construction of these forms and supports see paragraphs 76 and 77, page 15.

The amounts of materials required for a concrete cellar 20 feet long, 10 feet wide and 7 feet high, inside dimensions, are 175 bags of Atlas Cement, 350 cubic feet of sand, 700 cubic feet of gravel or crushed stone, 40 rods 11 feet 4 inches long 5 rods 5 feet 6 inches long, all ⅝ inch diameter.

After the cellar has been completed you can build bins of any desired size and height. Lumber is more commonly used for bins so that they can be built more easily and moved to any new position.

This same type of structure is sometimes used for an incubator cellar, a cyclone cellar or a bee cellar.

Forms for walls are described on page 13.

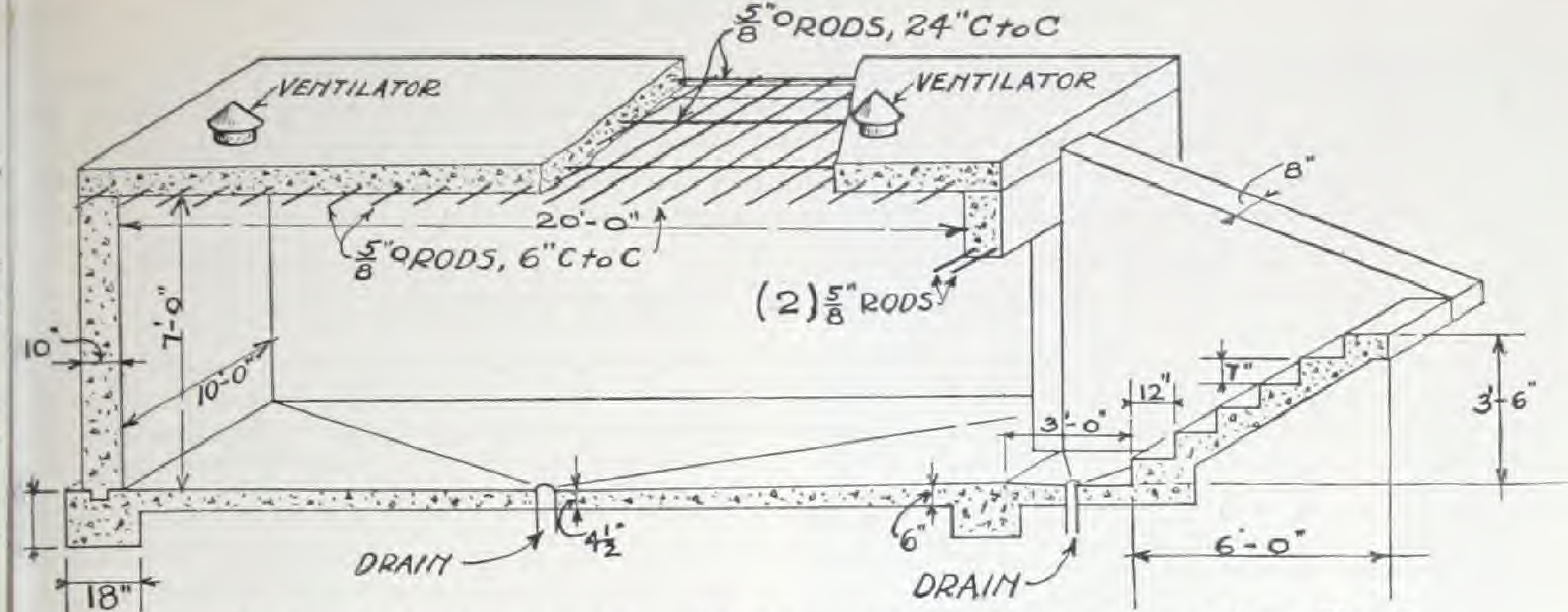


Fig. 34—Detail plan for root cellar with flat concrete roof. For wooden roof see Fig. 35.

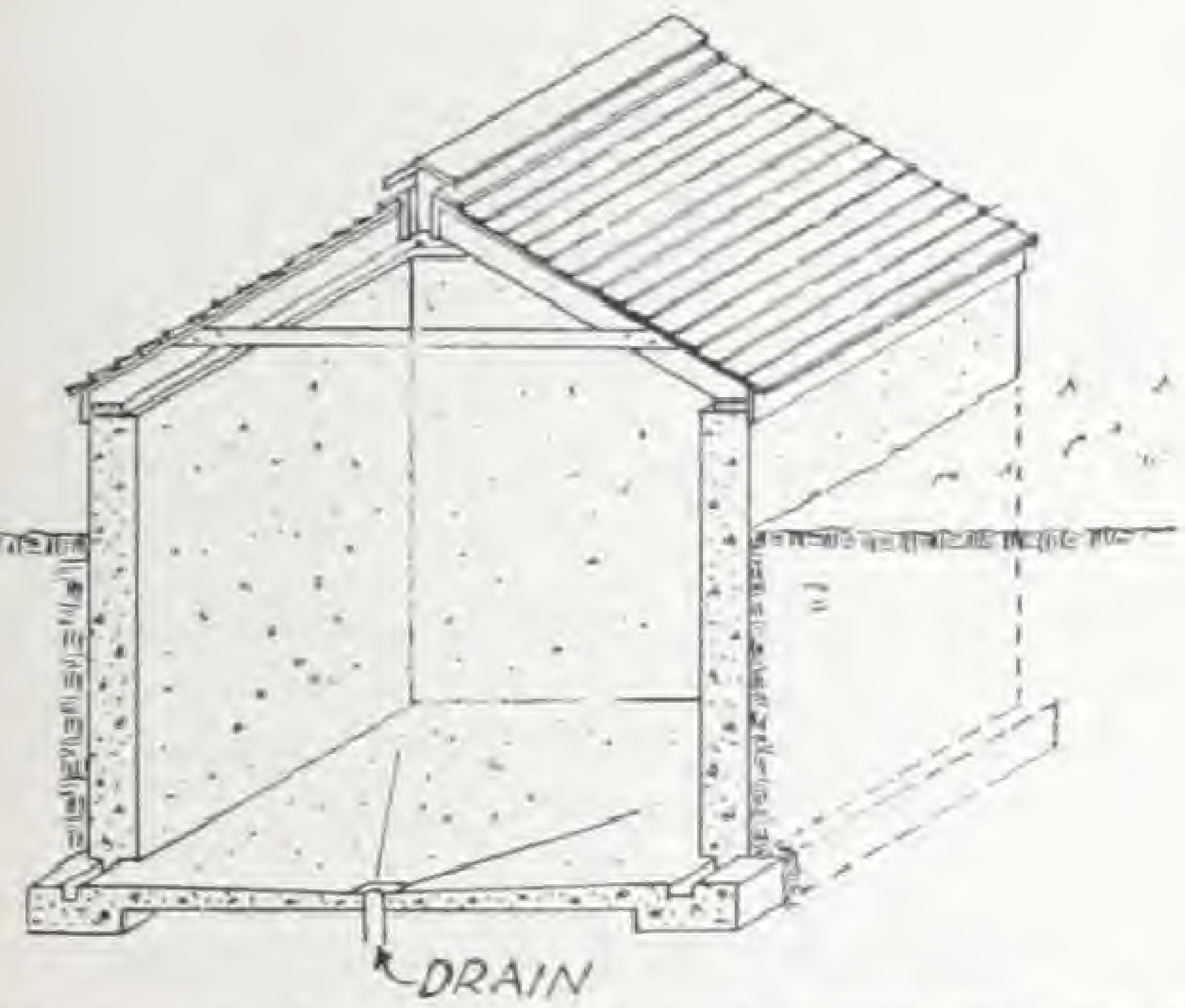


Fig. 35—Detail of a section of root cellar or small ice house with wooden roof.

Fig. 36—Ice house with excavated approach.

Fig. 37—Round top root cellar with hatchway.

Fig. 38—Concrete root cellar built in a bank with front retaining walls.

Forms for roofs are described on page 15.

Concrete steps and hatchways

Steps should be built of some permanent material which will not decay. This is particularly importa[nt] if they rest upon the ground. Wooden steps constantly absorb moisture and therefore rot in a short tim[e].

Two types—Concrete steps are of two types: First, those which rest on the earth—that is, are built [on] a slope; and second, those which extend from one floor to another, or from the floor to the ground, and a[re] supported at each end like a slab, so that they require reinforcement.

Construction of concrete steps

Taking up the construction of the first type of steps, those *built on a slope:* The slope should be thoroughly tamped and solid enough to hold the concrete without any settlement. Steps of this type are ordinarily not reinforced.

The *forms* consist of two planks held against side walls by 2-by-4-inch boards and wedges, as shown in Figure 40. To these are nailed 2-by-4-inch boards which come to within a couple of inches of the treads. To the 2-by-4's are nailed the cross planks (usually 2 inches by 8 inches), which form the risers.

If you build steps without side walls, then make your forms out of planks according to the risers and treads of the steps, and nail the forms for the risers to the planks. The forms are practically the same as for reinforced concrete steps, described below.

The mixture should be 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

You can safely remove the forms for the risers after 24 hours under ordinary conditions, and then the face of the risers should be brought to a smooth finish by using a wooden float—rubbing the face well until it presents a smooth, even textured finish.

Self-supporting concrete steps

The second type of concrete steps are built in a slightly different manner, since they are self-supporting.

Forms—The forms required are shown in Figure 41. They consist of a panel of ⅞-inch tongued-and-grooved sheathing, cleated together about 12 to 14 inches wider each side than the steps. This panel is supported on 4-by-4's running lengthwise of the steps. These are supported on 4-by-4-inch bents or posts, as shown in the drawing. Two-inch planks, cut to the shape of the steps, constitute the side forms. They are nailed to the panels and braced on the outside. Riser boards, 2-by-8-inches are nailed upright to form face of steps.

Mixture—Use concrete mixed in proportion of 1 part Atlas Cement, 2 parts sand and 4 parts gravel or crushed stone.

Reinforcement—Before the concrete is poured—better y[et] before the risers are put in position—place the longitudin[al] reinforcement as shown in Figure 42. This should be 1 in[ch] from the bottom of the slab. The amount to be used is give[n] in the table below.

It is usually all right to remove the side forms and ris[er] forms within 24 hours after the concrete is poured. To secu[re] a satisfactory finish, rub the exposed surface with a woode[n] float dipped in water. The forms and shoring supporting th[e] slab should be left in place for at least 3 weeks.

Fig. 39—Detail of different step treads and forms for them.

Figure 39, on this page, shows three different types of rise[r] forms. For 10 steps, each step 7 inches, risers 10 inche[s] tread and 24 inches long, you will need 2 bags Atlas Cement 4 cubic feet sand, and 8 cubic feet gravel.

Hatchways of concrete

Concrete steps are well suited for hatchway construction and for this purpose are usually of the first type, that is, built directly on a slope. This form of construction, shown in Figure 44, can be easily adapted to the particular conditions which you are called upon to meet.

Concrete walls forming the hatchway are built in the same way as basement walls (see page 20), and of the same thickness and mixture. Have them built at the same time that the basement wall is constructed, if you possibly can, so that they will tie into the main part of the wall. Bolts should be placed in the top of the wall when it is poured, so as to allow the cellar door to be anchored securely.

TABLE OF REINFORCEMENT FOR CONCRETE STEPS

No. of Steps	Clear Span		Thickness Slab	Reinforcement		No. of Steps	Clear Span		Thickness Slab	Reinforcement	
				Diameter	Spacing Rods					Diameter	Spacing Rods
	Feet	Inches	Inches	Inches			Feet	Inches	Inches	Inches	
4	2	2	4	¼	10 inches	8	5	6	5	¼	5 inches
5	3	0	4	¼	10 inches	9	6	4	6	¼	5 inches
6	3	10	4	¼	7 inches	10	7	2	6	⅜	5 inches
7	4	8	5	¼	7 inches	11	8	0	6	⅜	6 inches

General information on reinforcement is on page 18.

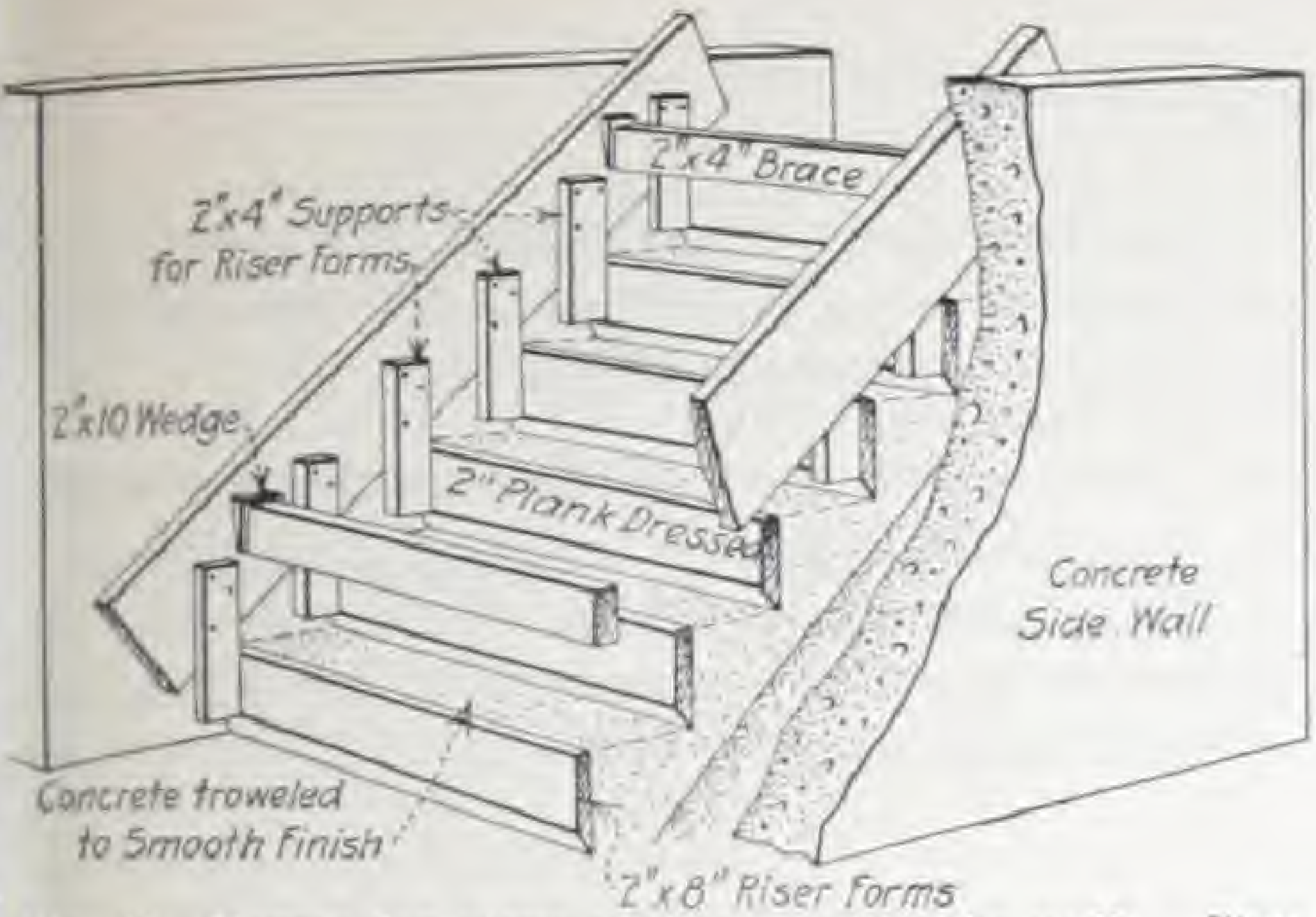


Fig. 40—Forms for steps with concrete side walls. Step slab resting on the ground.

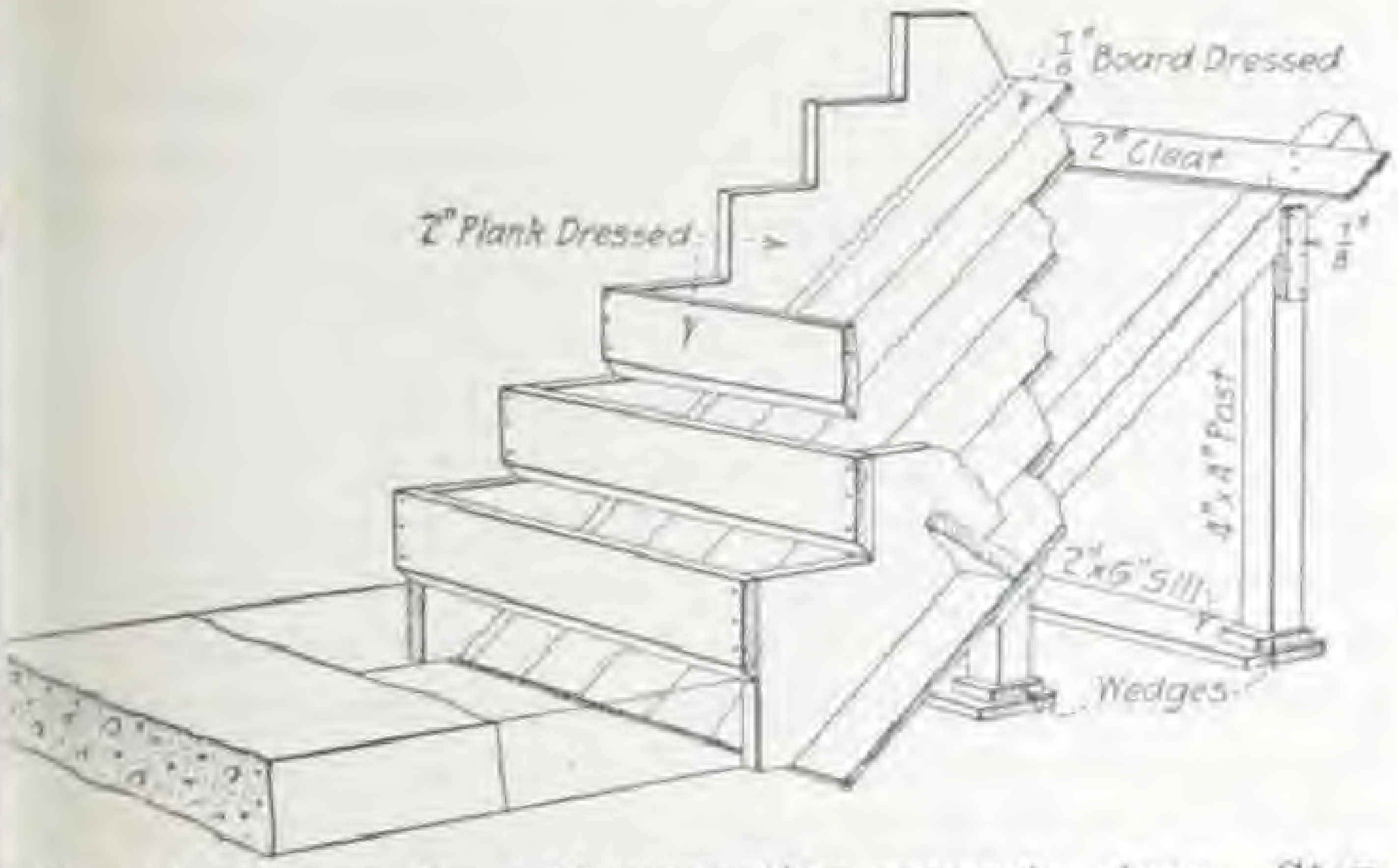


Fig. 41—Forms for self-supporting concrete steps. Step slab reinforced as shown in Fig. 42.

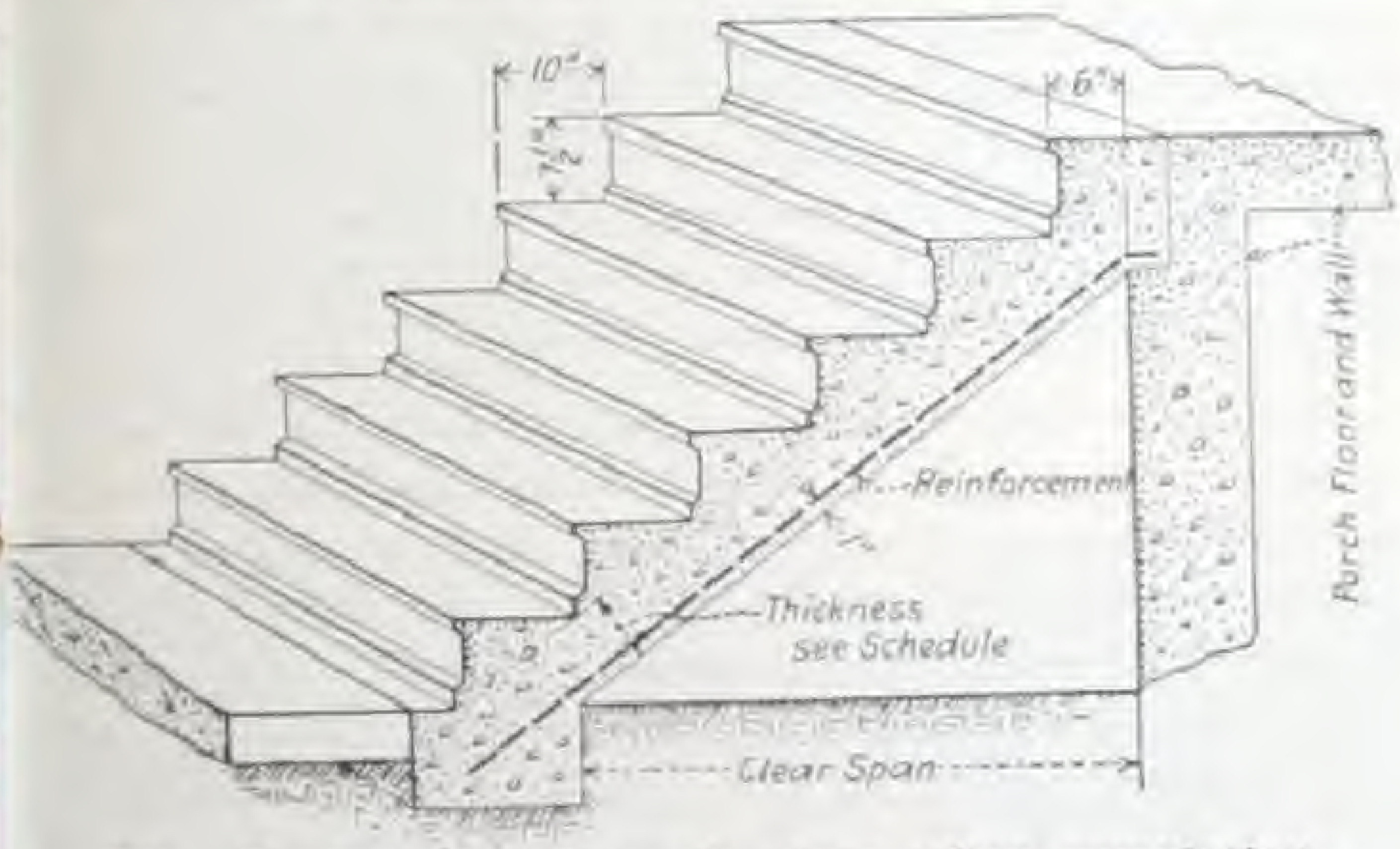


Fig. 42—Details of porch steps after completion.

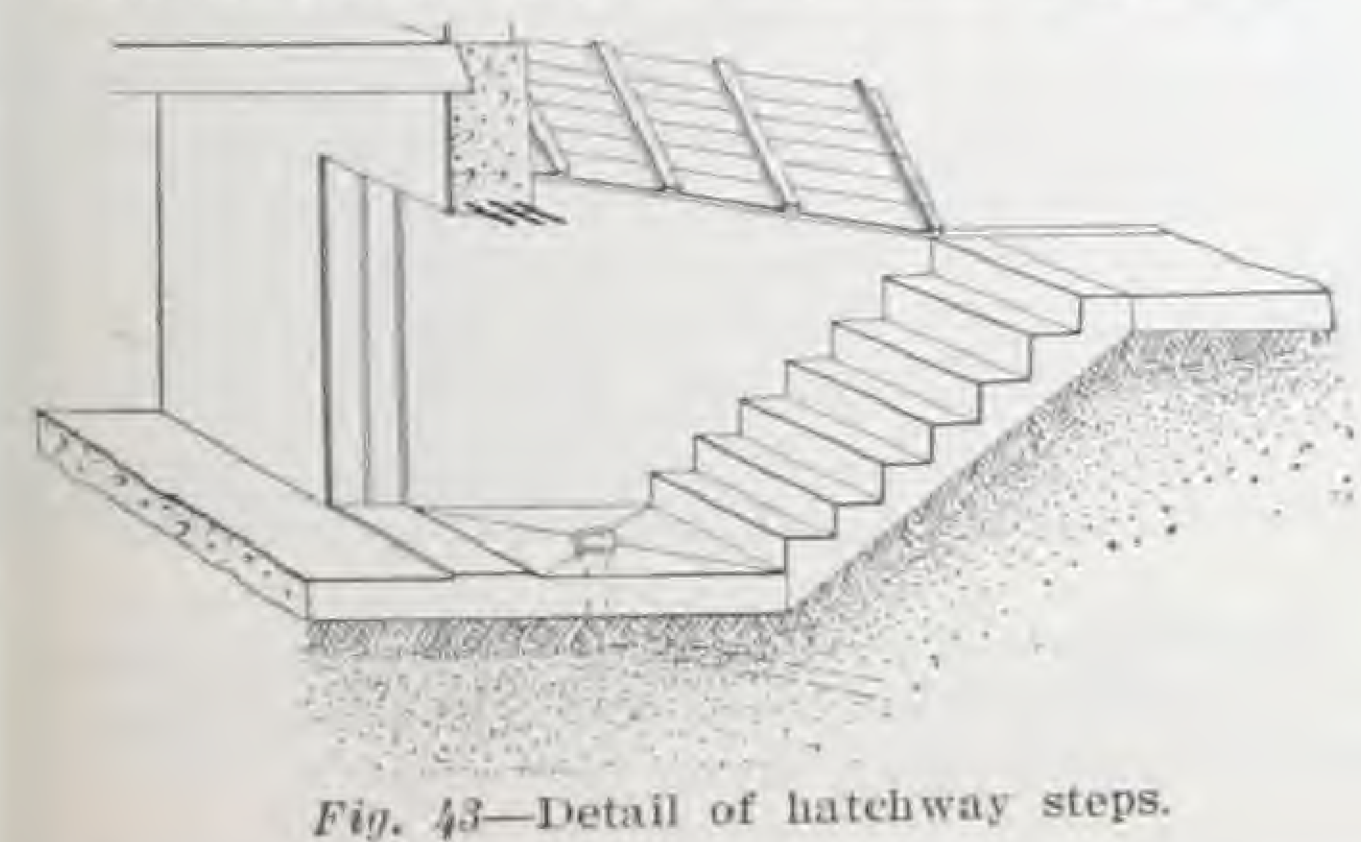


Fig. 43—Detail of hatchway steps.

Fig. 44—Concrete steps with concrete side walls, as shown in Fig. 40. For description of walls, see pages 12 and 13 on forms and page 74 on construction in general.

Fig. 45—Concrete cellar steps—inside and outside, as shown in Fig. 43 to the left—a very economical, safe and permanent method of construction.

For construction of cellar floors, see page 32.

Concrete sidewalks

Concrete sidewalks are easily built, present a neat appearance, and are permanent. They furnish a safe and hard surface at all times of the year for convenient travel between or around the different buildings of your farm. They are never muddy, never dusty. It is easy to remove snow from them.

There are two types of concrete sidewalk construction: the *one-course* type, which is a uniform mixture of cement, sand and stone throughout; and the *two-course* type, which consists of a base of concrete and a finish of cement mortar, made of cement and sand only. The advantages of the one-course type are that it is much more easily constructed and that there is a saving in the material required. The only advantage gained by the two-course construction is that the walk will have a smoother and denser surface.

How to build them

Foundation—It depends on the character of the soil where you are going to build a walk what precautions it is necessary to take in providing a proper foundation. Sandy soils drain themselves, but soils that are principally clay will hold water and cause it to accumulate underneath the walk. If you build a walk over soil that retains water or in a place where ground water comes near the surface at certain times of the year, you will have to see to it that the ground is drained to take care of any accumulation of water that may settle there.

Excavation and drainage—Excavation for walk construction in any self-draining soil need be only as deep as the thickness of the concrete slab for the sidewalk. Where the soil is not self-draining, you should excavate 10 to 12 inches and refill this extra 6 or 8 inches with cinders, gravel or broken brick to provide a porous sub-base which will drain off any water that might accumulate underneath the slab. If there is a likelihood that a large amount of water will accumulate underneath the slab at any time of the year, a land tile drain should be installed to take this water away from beneath the walk itself, to a lower level. Neglect of proper foundation preparation may cause complete failure of the walk.

Tree roots and other vegetable growths must be taken out from the soil beneath the walk at least 15 inches below the ground surface. Soft or sandy pockets in the sub-base should be filled with hard, firm material so that the ground sub-base upon which the concrete walk is to be placed will present a uniformly hard and well compacted surface.

Materials and mixing—The material required for concrete construction should be carefully selected—the selection of proper material is covered in paragraph 28, page 6. Mixing the concrete may be done either by hand or machine. See page 10.

Forms—The only forms needed are 2-by-4-inch planks set on edge and held in place by stakes driven in the ground on the outside. These forms restrain the concrete while it is still soft and so give it the desired shape for future use.

Expansion joints—Concrete sidewalks, whether of the one- or two-course type should never be constructed *in one piece*. They must be divided into slabs or units, about 5 feet long. These joints or separations of the slabs provide for the expansion and contraction of the slabs as the temperature changes. They are made during construction of the walk by placing several thicknesses of tar paper or ¼-inch boards across the walk between the side forms at intervals of 5 feet; the concrete is deposited on either side. If the ¼-inch board is used, it may be removed when the concrete has set. If tar paper is used, it may be left in the walk without harm. Separation of the concrete into separate slabs is sometimes accomplished by cutting through the slab with a steel trowel or other sharp tools while it is still soft and before it is set. If you separate the slabs completely, this method is all right.

One-course type

Mixtures—The one-course concrete sidewalk is constructed of a mixture of 1 part Atlas Cement, 2 parts of sand, and 3 parts of broken stone or gravel. For each 100 square feet of sidewalk, 4 inches thick, allow materials as follows: 9 bags Atlas Cement, 18 cubic feet sand, 27 cubic feet of gravel or crushed stone—8 hours' labor of two men. Figure for any other thickness proportionately.

Thickness—The concrete is deposited between the forms, usually 4 inches thick, leveled off to the desired elevation of the walk surface by a strike-board, that is, any ordinary rough board with a straight and true edge—which rests in the side forms and is moved across and back with a sawing motion, and gradually worked forward also. The surface left behind the strike-board is true and uniform. The top of the concrete should be level with the ground, but never lower.

Finishing—The rough surface left by the strike-board should be allowed to set only until excess water is absorbed by the concrete mass. Then give it a final finishing with a wooden float (see Fig. 21). Do not use a steel trowel for finishing, as it gives a smooth surface that is likely to be slippery. The wooden float levels the surface, and eradicates imperfections and leaves a sandy surface that is not slippery.

Two-course type

Proportioning—The *two-course concrete walk* is constructed of a concrete base-course mixture of 1 part Atlas Cement, 2½ parts sand, and 5 parts of broken stone or gravel; and of a

top or surfacing coat of cement mortar, made of 1 part Atlas Cement and 2 parts sand. Allow for each 100 square feet (for example, a walk 25 feet long and 4 feet wide), 4 bags of Atlas Cement and 8 cubic feet of sand for the mortar top coat, 1 inch thick; and for the base course, 3 inches thick, 4½ bags Atlas Cement, 11¼ cubic feet sand, and 22½ cubic feet gravel or crushed stone. To build 100 square feet, allow the labor of two men for about 10 hours.

Thickness—The base-course is deposited first, 3 or 4 inches thick—4 inches, if the walk must sustain heavy loads—and then roughly leveled off with a strike-board, as explained for the one-course type. Inside of 30 minutes the top or surfacing coat of mortar at least 1 inch thick must be placed on the base-course. If the top course is not placed almost immediately after the base-course, the two will not knit or bind together in a solid mass.

The mortar top coat may be struck off by means of a strike-board to the desired surface level, as with the one-course sidewalks.

The finishing of the two-course walk is usually done first with a wooden float to eradicate any great surface irregularities and then with a steel trowel. Too much troweling should be avoided as it gives a very smooth surface. Besides, the steel troweling tends to bring the cement to the surface, and if that is done the walk will not wear as well as one that has the grains of sand close to the wearing surface.

Protection during curing—Protection of concrete on all exposed areas from the elements during the setting period has been explained already in paragraph 55, page 11, but particular precaution must be observed for sidewalks, as there is the absorption by the ground and the evaporation from the sun or hot winds. It is, therefore, usually advisable to cover the finished surface with canvas, burlap or tar papers. As soon as the concrete has set sufficiently to prevent pitting of the surface, it should be sprinkled and kept moist continuously for at least a week. A 2-inch covering of earth or sand will help to retain the moisture and prevent rapid evaporation.

Fig. 46—A large paving job, with machine mixer.

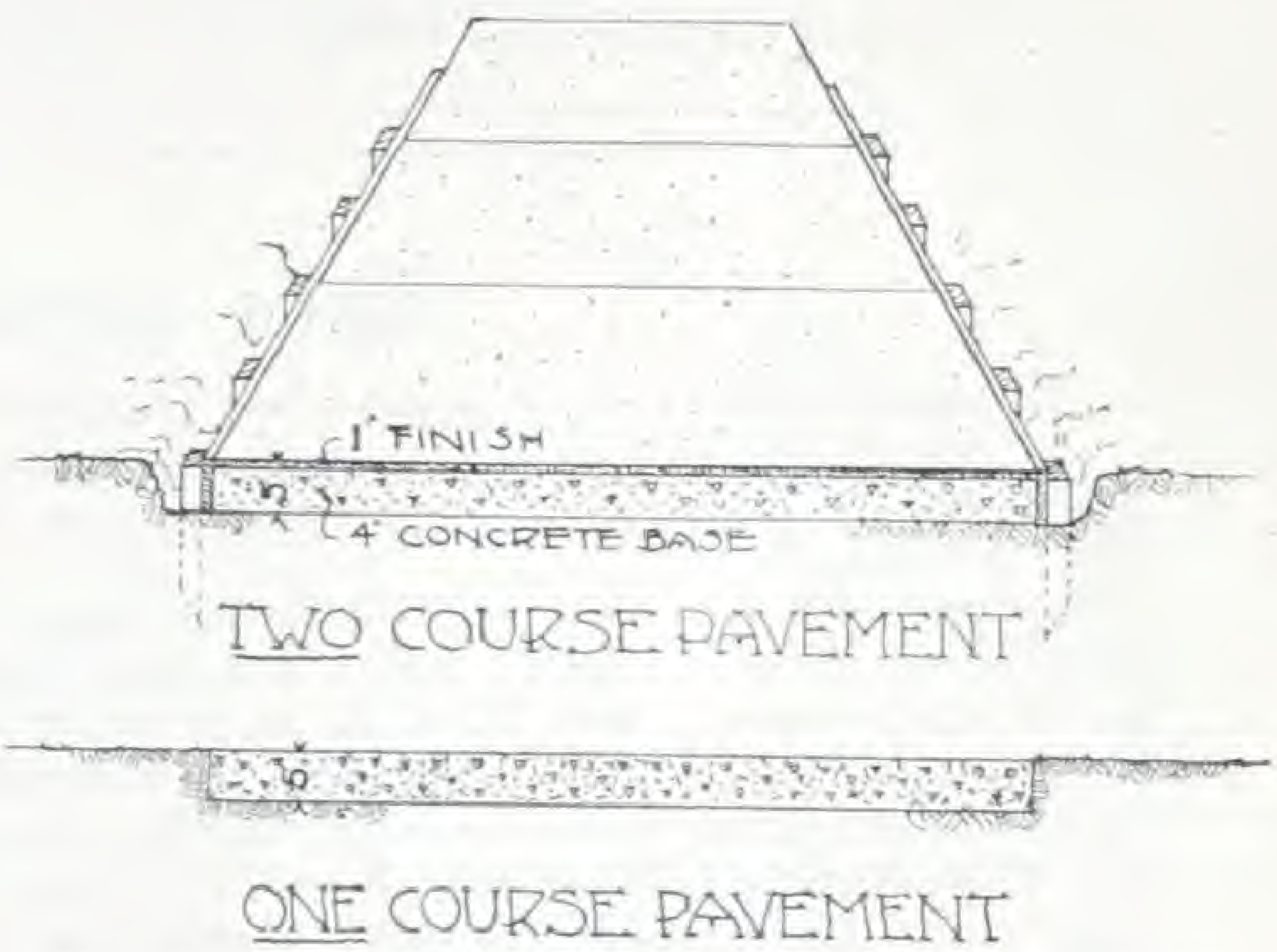


Fig. 47—Details for construction of one-course and two-course pavement.

Fig. 48A—Building a small sidewalk in a country village. Two men at work—one wheeling and dumping, the other smoothing the concrete with a shovel.

Fig. 48B—A small paving job. Four men at work—one mixing by hand, one carrying with wheelbarrow, one filling the forms, and one tamping.

Instructions for washing and grading sand and gravel are on page 5.

Concrete driveways for the farm

Driveways of concrete about farm buildings where there is considerable teaming assure easy access to the different buildings at all times of the year. They avoid the nuisance of mud holes and the mired loads that strain both horses and wagons. They are permanent and easily built.

Size—For farm trucking an 8-foot driveway is usually considered the minimum width. If loaded wagons have to pass, the road should be at least 12 feet wide.

Foundation—Instructions for drainage and foundation preparation are found on page 28, on sidewalk construction.

Thickness—For an 8-foot road the concrete should be 5 inches on the side and 6 inches in the center. This provides lateral drainage for surface water and keeps the pavement clean. For a driveway 12 feet wide, make the thickness 5 inches on the side and 6½ inches in the center. For a 16-foot width, make the concrete 5 inches thick at the side and 7 inches at the center.

Placing and finishing—Place the concrete between side forms as in sidewalk construction; see page 28. The shape or crown of the road is given to it in finishing, with a template made of a 2-by-8-inch plank, cut to the shape of the desired crown on its lower edge for a distance equal to the width of the road, but with the ends, beyond the curve, straight. With these ends resting on the side forms, the template should be drawn across the surface of the soft concrete.

A wooden float should be used to get rid of surface irregularities. The surface thus formed will be dense and gritty, never slippery, and will withstand any load. A wood bridge, consisting of a 2-by-10-inch plank supported at each end on a 10-inch upright base, makes it possible to bridge over the road and use the wood float without walking on new concrete.

Quantities required—For a roadway 8 feet wide, 5 inches thick on the side and 6 inches in the center, allow for each 20 feet of length (using a mixture of 1 part Atlas Cement, 2 parts of sand and 3 parts of stone or gravel) 19 bags Atlas Cement, 38 cubic feet sand and 57 cubic feet gravel or stone.

Barn entrances that last

Entrance floors of concrete provide a permanent and safe entrance over the sill of the barn. The usual bump which jolts the load and strains the wagons and horses is cheaply and easily prevented by constructing an incline of concrete, sloping from the entrance road surface to the level of the barn floor.

Foundation—There is considerable shock or strain on a barn entrance and it is, therefore, best to carry the foundation for the concrete at least 24 inches below the surface right at the door as shown in Figure 52. The excavation should be about 1 foot wider on each end than the entrance door itself and should extend away from the building for about 3 feet. This excavated area should be refilled up to 3 inches from the roadway surface with field stones, the larger at the bottom and the smaller on top. Forms for these foundations are not required if the earth is firm. Otherwise, follow directions on page 13, regarding forms.

Excepting the foundation at each end, as shown in Figure 52, the approach has no foundation but is built right on the ground after you have excavated to a depth of 6 inches. Use side forms for this as in sidewalk construction on page 28.

Mixture—Concrete mixed in the proportion of 1 part Atlas Cement, 2 parts sand, and 3 parts of crushed stone or gravel should then be placed on this rock foundation and shaped to the desired slope of the entrance incline. For an entrance 3 feet long, 10 feet wide and 6 inches thick, allow 6 bags Atlas Cement, 12 cubic feet sand and 18 cubic feet gravel or crushed stone.

Barn and stable floors

Barn and stable floors of concrete used to be considered a desirable improvement. They are now considered a necessity. They are permanent and clean. Some state laws require them.

Foundation—The only foundation required is a firm compact soil area 5 or 6 inches lower than the floor level. This should be sloped to a drain or gutter, as in cellar floors; see page 28. If the natural soil is not firm and solid, you had better excavate about a foot, and then put in a 5 or 6-inch layer of gravel as a base, well packed down.

Floor—If you want your floor to slope, you must slope the grade before you start to pour the concrete.

If your floor is more than 10 feet in any one direction build it in sections—any size you need; see page 36.

Thickness, mixture, etc.—The concrete should be 5 inches thick if the loads hauled over it will not be heavy, but if you intend to haul hay or manure, the concrete should be 6 inches thick. It should be mixed in the proportion of 1 part Atlas Cement, 2 parts sand, and 4 parts broken stone or gravel. The concrete should be finished with a wooden float only. Keep it moist for at least five days after it is in place, and protect it from travel for at least that long.

Quantities required—For each 100 square feet of floor (10 feet wide, 10 feet long, for instance), 6 inches deep, you will require 11 bags Atlas Cement, 22 cubic feet sand, and 44 cubic feet broken stone or gravel.

Read pages 87 to 91 on better roads.

Fig. 49—Concrete driveway around barn. The rutted dirt at the side shows how much harder hauling is without the concrete driveway.

Fig. 50—Detail for concrete driveway between farm buildings—dimensions and instructions are given in the text on the opposite page.

Fig. 51—Barn entrance of concrete with scored surface.

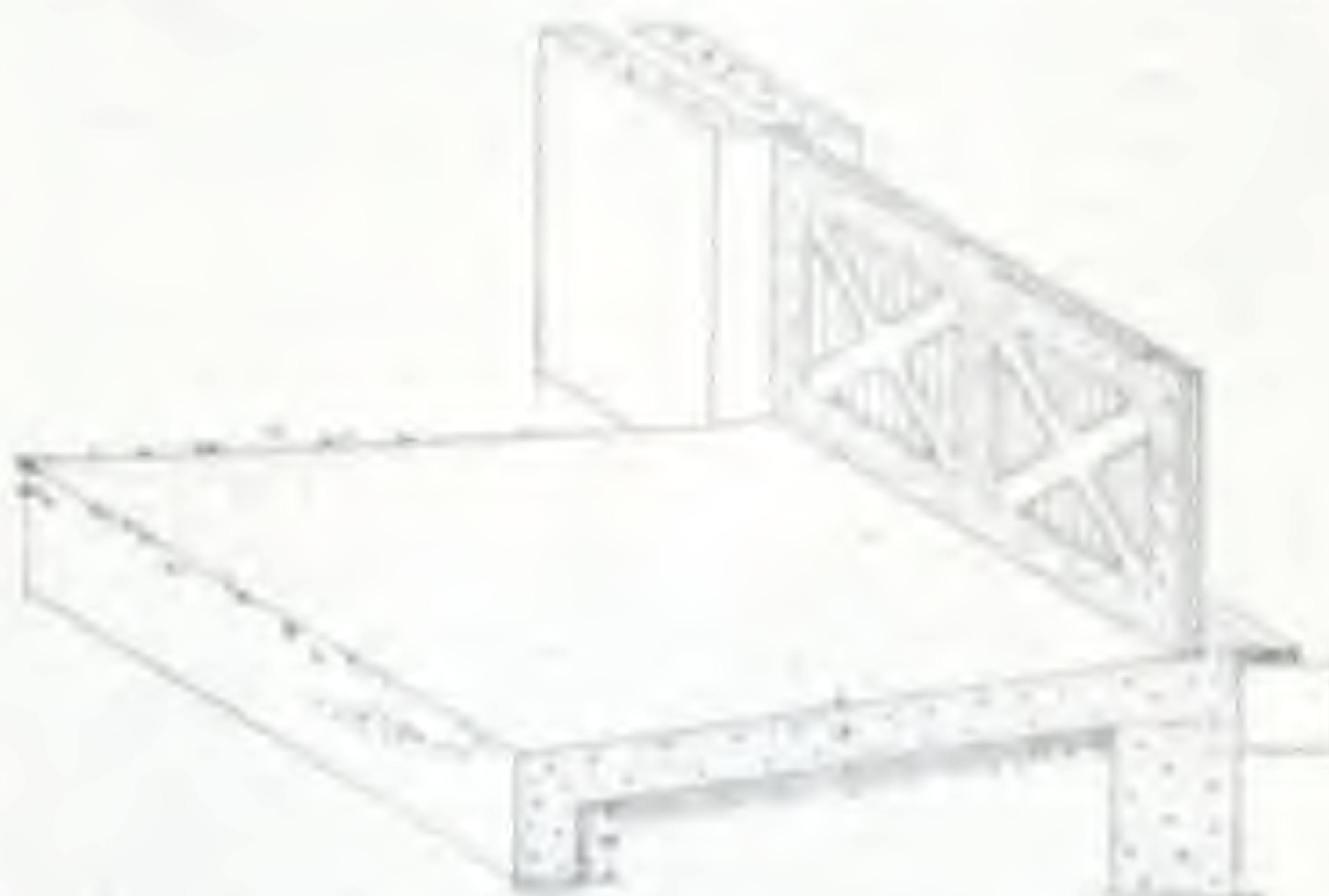


Fig. 52—Detail for concrete barn entrance.

Fig. 53—Concrete floor for horse and carriage barn.

Fig. 54—A barn floor of concrete.

How to place concrete is told on page 11.

Cellar floors that are safe and dry

Concrete cellar floors are the custom. They are sanitary because they are permanent, will not rot, have no cracks to accumulate refuse or vermin, and may be easily cleaned. They are fireproof.

Concrete floors, like concrete sidewalks, may be constructed in one course or two courses. See page 28. No expansion joints are needed in a basement floor where temperature changes are not great.

Excavation, drainage, etc.—First excavate to a depth 4 inches lower than the finished floor surface is to be. Then tamp the ground thoroughly. If you wish to provide a drain so that the floor may be washed, this drain must be placed underneath the ground level before the cellar bottom is prepared for the concrete, and the sub-base or ground of the cellar bottom will have to be sloped so as to provide drainage from all directions into this outlet. Because the concrete is 4 inches thick throughout, the slope must be provided on the base and *not in the concrete.*

Forms—If the drain is to be in the center of the cellar, it is a good plan to set 2-by-4-inch boards on edge, sloping 3 inches from the four corners of the cellar to the drain in the center. By the height of these boards you can measure the thickness of the concrete. Any board with a straight and true edge can be used as a strike-board—that is, be drawn back and forth on these 2-by-4's so that the excess concrete is driven ahead of the strike-board leaving a perfect grade behind it.

Remove the 2-by-4's as soon as the concrete is placed around them, and as you take them out fill concrete into the space left. Stand on a 12-inch board while you are doing this—for you do not want to walk on the green concrete.

Mixture—For the *one-course* floor mix the concrete in the proportion of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel. Deposit it 4 inches thick. Level it off and finish it immediately, first with a wooden float and then with a very few strokes of a steel trowel.

For the *two-course* floor the mixture should be 1 part Atlas Cement, 2½ parts sand, and 5 parts crushed stone or gravel. Place this 3¼ inches thick. As soon as this has been struck off, the top or surfacing coat of mortar—a mixture of 1 part of Atlas Cement and 2 parts of sand—should be deposited over the concrete base about ¾ inch thick and should be trowelled immediately to the desired surface with a steel trowel.

Material and labor required—For each 100 square feet of *one-course* floor, 4 inches thick, you will need 7½ bags Atlas Cement, 15 cubic feet sand, and 30 cubic feet crushed stone or gravel, and the labor of two men for about 8 hours.

For a *two-course* floor, of the same dimensions allow 8 bags Atlas Cement, 18 cubic feet sand, and 25 cubic feet gravel, and the labor for about 10 hours of two men.

Porch floors

To replace an old wooden porch floor that has decayed, or to build a new porch floor, concrete is by all odds the best material to use. It is easy to construct a concrete floor, and it does not cost much. No repairs will ever be necessary. It will not rot, decay or burn. It can be easily scrubbed and cleaned.

Excavation—First—you will have to remove the old wooden floor and support the porch roof temporarily with 4-by-4-inch uprights. All loose material should be removed from the area which will be covered with concrete. As you will need a foundation and wall for the outer edge and sides of the porch dig a trench 3 feet deep, or at least below the frost line, and 10 inches wide.

Forms—Then construct forms for a concrete wall 10 inches thick. The method of building forms for this kind of work is described on page 13. Be sure that your forms for the front wall are set so that the top of your finished wall will be an inch or so lower than the inside line where you will make the top of your porch floor This will make your floor slope enough to drain easily.

Construct the wall of a mixture of 1 part Atlas Cement, 2½ parts sand, and 5 parts gravel or crushed stone.

After the concrete has hardened sufficiently, remove the forms and fill in the space between the front foundation and end walls and the main wall of the house with earth, to within 6 inches of the finished floor level. Tamp the fill thoroughly to get a good solid base.

Mixture—On this fill, place concrete mixed in the proportion of 1 part Atlas Cement, 2½ parts sand, and 5 parts gravel or crushed stone, to a thickness of 5 inches. Level this off and place immediately the top or finishing coat of mortar mixed in the proportion of 1 part Atlas Cement and 2 parts sand. Finish with a steel trowel. Keep the floor moist for at least 5 days, to allow the concrete to set.

Quantities required.—For a porch floor 5 feet wide, 20 feet long and 6 inches thick, with foundation walls, 3 feet below ground and 2½ feet above, and 10 inches thick, you will need 31 bags Atlas Cement, 75 cubic feet sand, 134 cubic feet gravel or stone.

Fig. 55—A concrete basement floor.

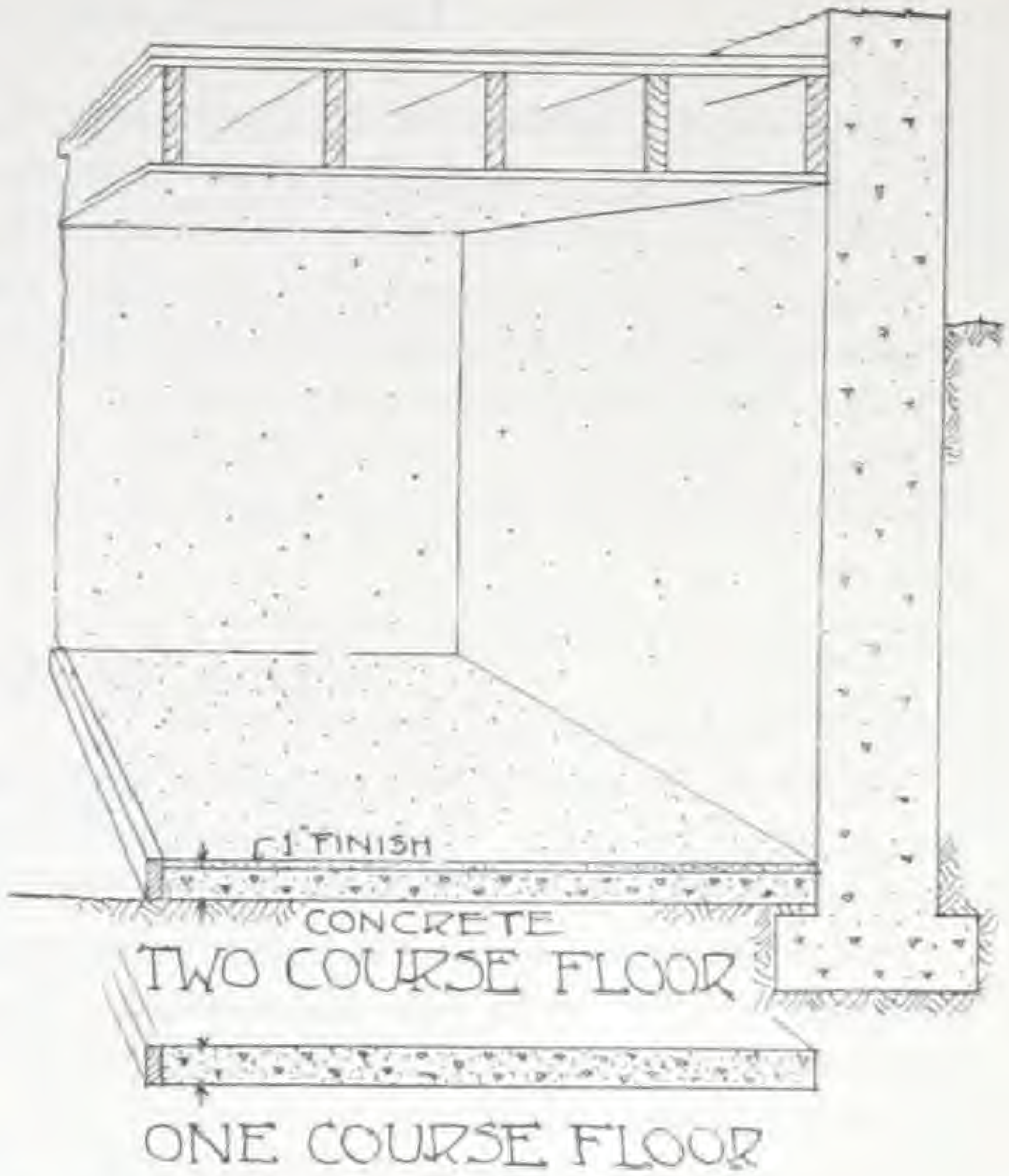


Fig. 56—Details for one- and two-course basement floor.

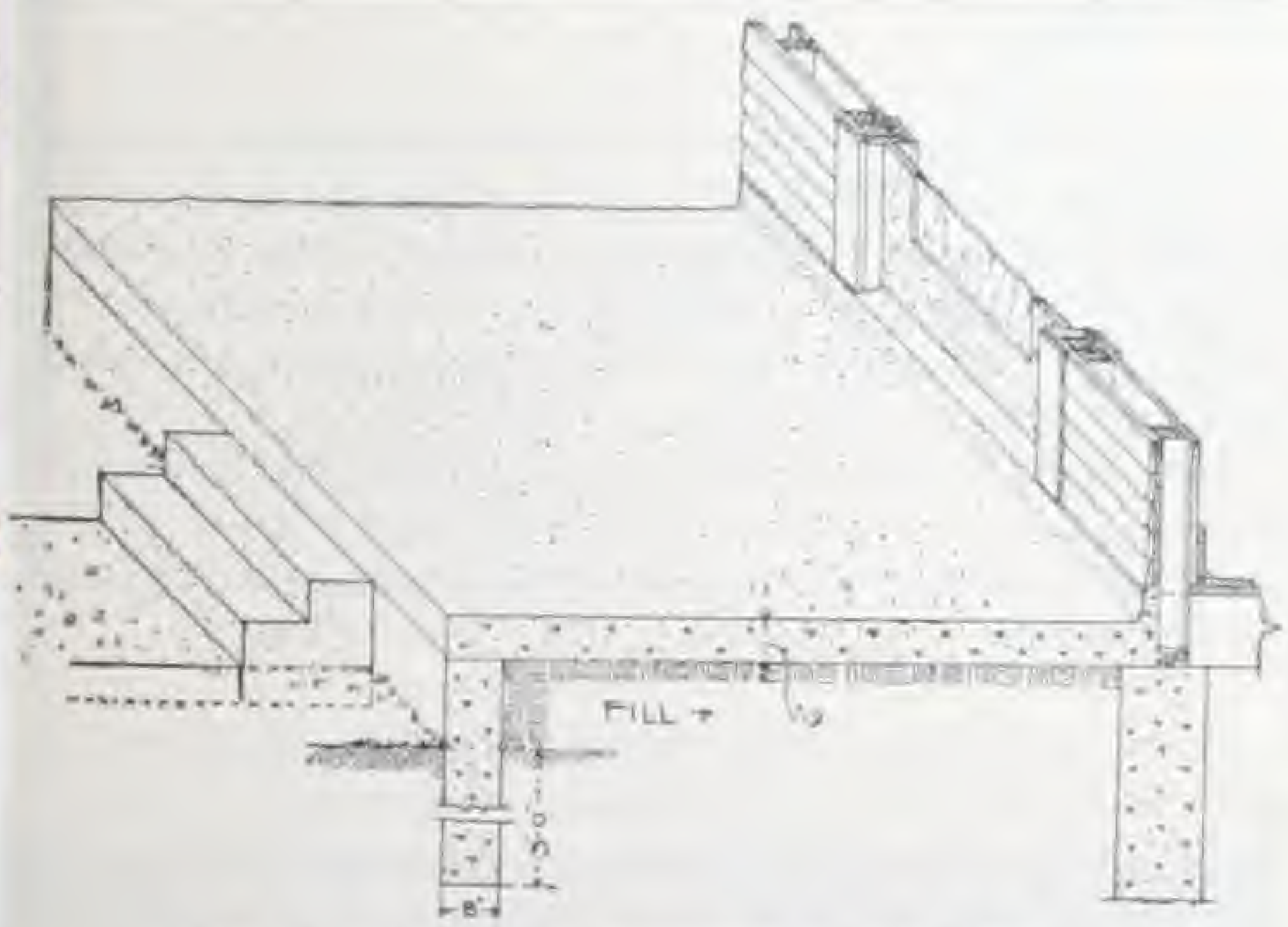


Fig. 57—Detail of concrete porch floor.

Fig. 58—Porch with concrete foundation, floor and steps.

Fig. 59—Concrete porch floor and pump platform—showing spikes in floor to tie pillars to the floor.

Economical cow barn floors

Cow barn floors of concrete are best because they will not absorb the moisture and odors of the stables, and hence provide a sanitary surface which you can easily keep clean. Concrete floors are cheap because they are permanent and do not rot or decay, nor require upkeep or renewal expense.

It is not necessary, in order to have sanitary cow barn floors, to build an entire new barn, and it is part of our object in this section on cow barn floors, to show you how you can put a modern up-to-date floor in a barn building which you now have. You can build one stall or 100 on the basis of the plan which we show in this section. You can do the work yourself with the labor you have on the farm if you carefully observe the precautions and construction description given in this book.

Plans for model cow barns

Figures 60, 61 and 62 show sections of a standard cow barn floor, arranged so that the cows face toward the center of the barn. With this arrangement there can be a central feed alley, where the fodder and grain can be fed from the driveway running through the center.

Figure 63 shows a section through a cow barn where the cows face toward the outside of the barn. This arrangement is better for removing manure. The 8-foot driveway through the center allows for a central driveway through the barn and the manure may be shovelled directly into a wagon and taken from the barn without re-handling.

Both these layouts allow for 35-foot barns, with stalls each 4 feet 8 inches, mangers 3 feet 6 inches, and gutters 1 foot 4 inches.

Easily built in concrete

Construction—You should not try to construct the floor clear across the building or for the length of your cow barn in one operation, but take a small section, say half the width of your barn and three or four stanchions long. Excavate the floor of your barn 5 inches below the desired grade of your finished floor, because the concrete will be placed 5 inches thick.

Figure 64 gives the dimensions of the litter alley, the gutter, the stall, the manger and the feeding alley. If you are going to construct this floor yourself and have not the time to lay very much concrete at one time, then you can first build the litter alley; then put in the gutter and the stall; and at another time put in the manger, being careful to lay out just the amount of work for each day that you can be sure to finish satisfactorily. Use a plank set on edge at the division line between the litter alley and the manger, or between the stall and the manger, and you will have a joint between one day's work and the next which will not affect the durability of the floor.

Figure 66 shows how to obtain the levels for the different sections, as the litter alley, the gutter, the stall, the manger and the feed alley. Follow this method if you desire to construct the floor in parts, and then you can do one section and be sure that the next section when it is joined to the one previously placed, will be in the right position and will join properly.

If you want to have the gutter slope to the manure pit so as to save and utilize the liquid manure, then the sub-base (or ground upon which the concrete is placed) must be sloped not less than one inch to every 4 feet, and not more than 1 inch to every 2 feet, to allow the water to drain to the sump or manure pit.

You should be very careful to pack the ground thoroughly after you have excavated to the desired level and before you place the concrete. Fill up any irregularities or soft places with firm soil.

Forms and mixture—For division forms use planks set on edge and staked in the sub-grade, so providing a barrier against which the plastic concrete is deposited and held in place until it has had sufficient time to set. Use 1 part Atlas Cement, 2 parts of sand, and 4 parts of crushed stone or screened gravel. Mix the concrete thoroughly. Make it only sufficiently wet to allow water to come to the surface when the concrete is thoroughly packed in place. When you have thoroughly mixed the concrete, deposit it 5 inches thick between the division forms.

Surface finishing—Careful tamping will bring the concrete surface to approximately the desired grade; then by means of a wooden float (see Figure 21, page 16) you may give the surface the final finish, which will be non-absorptive and gritty but not so slippery as if you were to use a steel trowel for finishing.

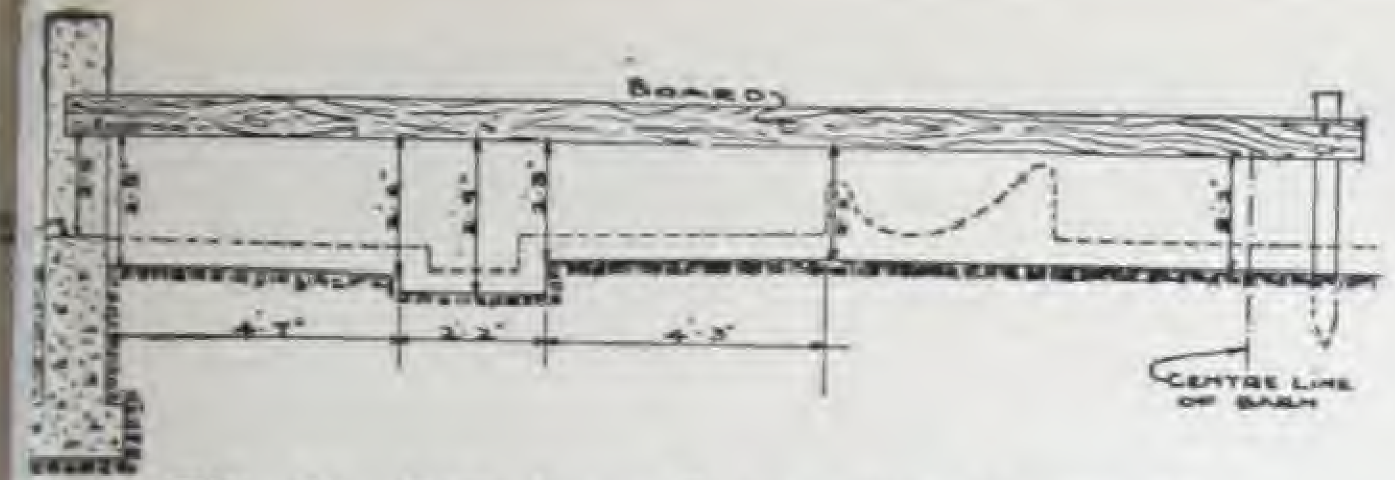


Fig. 60—Cow barn floor, cows facing *in*.

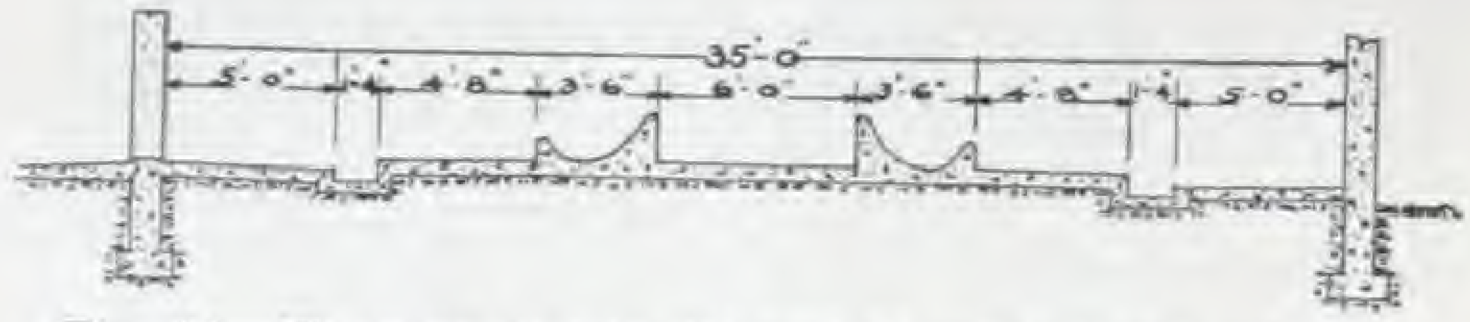


Fig. 62—Floor as in Fig. 60 and 61—full width of barn.

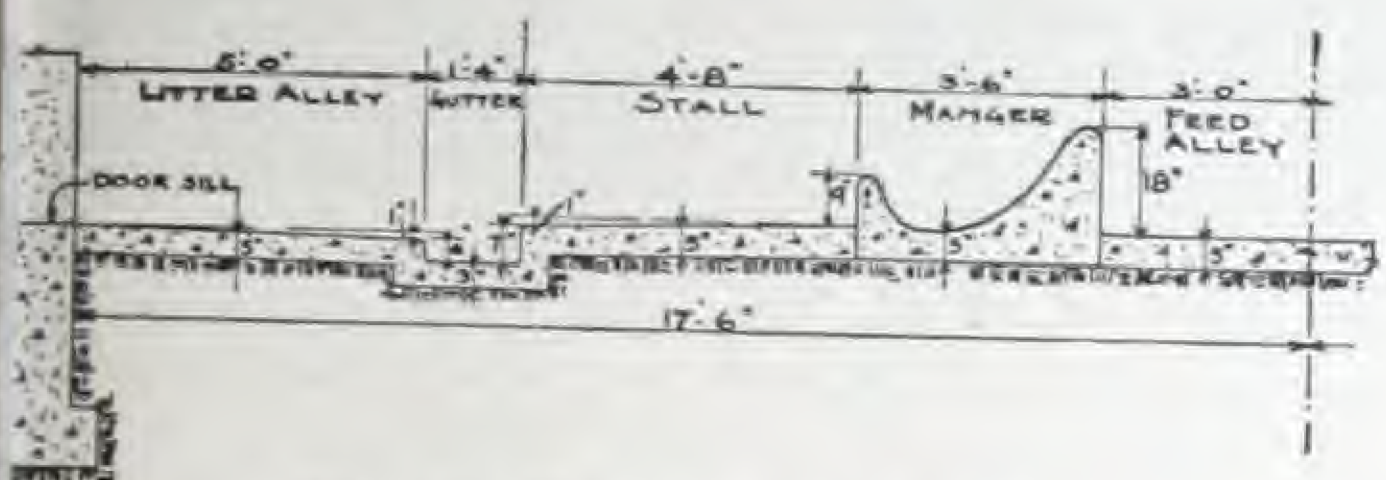


Fig. 61—Floor as in Fig. 60.

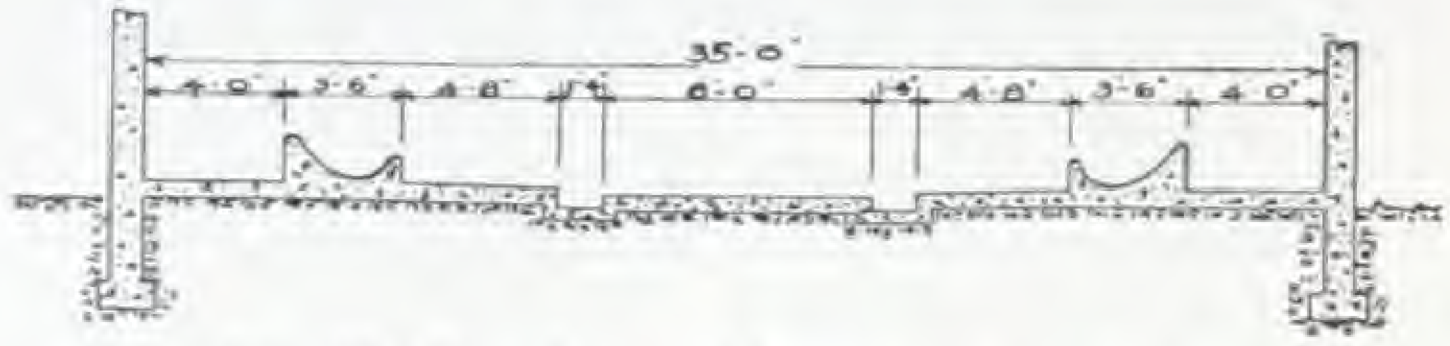


Fig. 63—Cow barn with cows facing *out*.

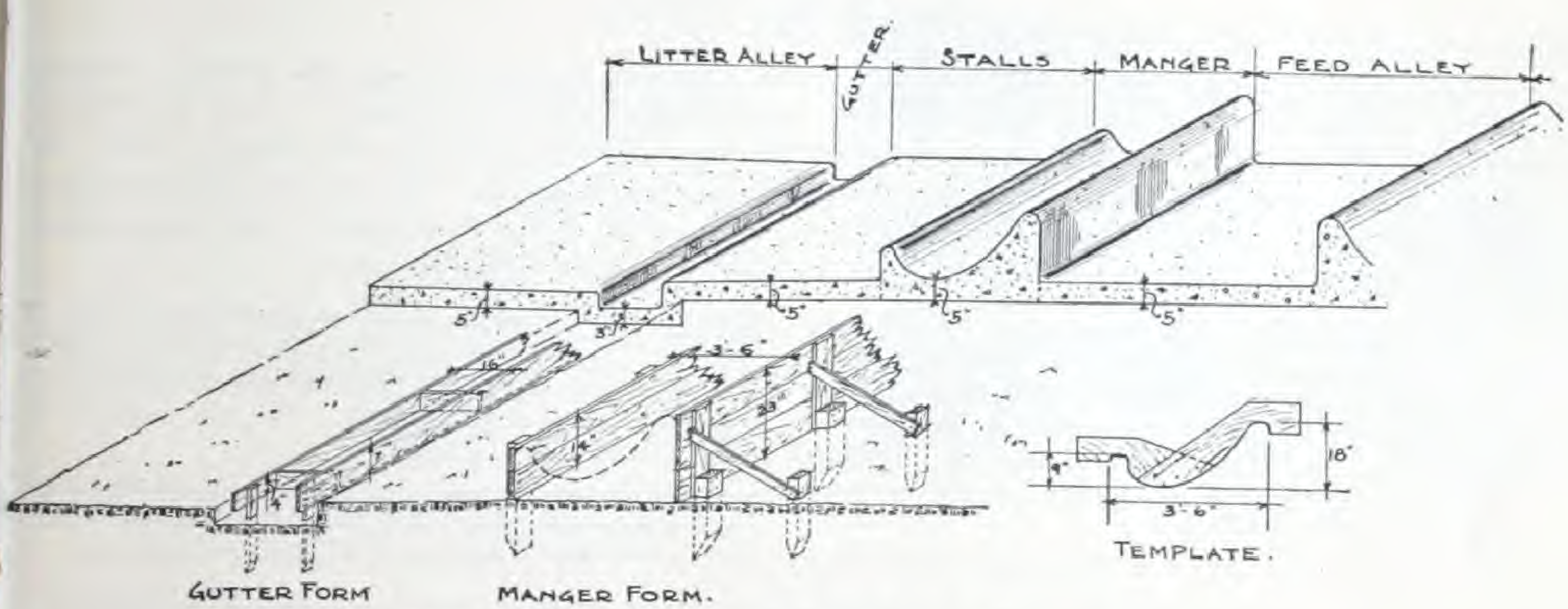


Fig. 64—Details of forms for cow barn floors, gutters and mangers.

Fig. 65—Cow barn with concrete manger, stall floor, gutter. The concrete gutter saves liquid manure, and helps keep the cows clean and healthy.

Fig. 66—Concrete cow barn with drinking troughs or mangers flanking the passageway, as in Figs. 60 and 61.

For barn approaches, see page 74; barns, page 48.

Concrete barnyard pavements

Concrete barnyards are clean and free from mud and filth at all times of the year, and they preserve the manure for hauling to the land where it is of value.

Construction—The foundation of a barnyard pavement must be given careful attention. If the location of the barnyard is such as to allow water to accumulate, follow the instructions on page 28 for installing a porous underdrainage for sidewalks. If the soil and surrounding area is self-draining, the excavation need only be carried to a depth equal to the thickness of the pavement—6 inches. When you are ready to place the concrete divide the area into 6-feet squares with 1-by-6-inch boards set on edge and staked to grade—that is, with the upper edge level with the finished grade of the pavement, as desired. If a slope in any direction is desired, slope the grade before placing the form boards. These boards act as guides for thickness and slope and divide the area into 6-foot squares. The concrete must be deposited and allowed to harden only in alternate squares. After the first squares have set, remove the boards and fill in the remaining squares. This provides contraction and expansion joints for the concrete. Otherwise the pavement would crack from temperature changes during the year. Place the concrete in these areas mixed in the proportion of 1 part Atlas Cement, 2 parts sand, 4 parts crushed stone or gravel. Strike off the soft concrete by a straight-edge board resting on the 1-by-6-inch forms, and finish with a wooden float.

Quantities required—A barnyard like this will need, for each 500 square feet of surface (20 feet by 25 feet, for instance), supposing it is 6 inches deep, 55 bags Atlas Cement, 110 cubic feet sand, and 220 cubic feet gravel or crushed stone. You can figure quantities required for different sizes in proportion to this or by referring to the table on page 8.

Feeding floors

When feed is tossed on the ground to hogs and cattle, they trample part of it into the ground. Feeding floors save this. They can be wood or concrete. A wooden floor is serviceable for a while but will not last, as it has to be laid on the ground and will eventually rot and decay; and even with a wooden floor, the cracks between the planks cause some loss of valuable feed and manure. The concrete feeding floor is the logical type to build. It has no cracks or seams, is free from decay, economizes on feed and manure, can be constructed easily and, as a general rule, will save its cost in a couple of years.

How to build—After having secured a good well-drained, compact foundation (as explained for pavements and walks, see page 28), construct the floor 6 inches thick of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. Lay it in sections 6 feet square. Use 1-by-6-inch boards for the side forms, staked upright. Let the floor slope to one side, ¼ inch to each foot.

Sometimes a curb is built around the edge, 4 inches higher than the floor, to prevent hogs and cattle from shoving off the feed. When this is done, the curb is usually extended into the ground at least 18 inches in order to prevent the hogs from rooting under the floor. This curb should be at least 6 inches thick.

The inside form for this curb is a 2-by-4-inch board held in position by overhanging cleats from the stakes of outside forms. See Fig. 74, page 38, in the description of curbs.

Carriage and automobile washing floors

Washing floors constructed of concrete will not rot and are far more attractive than wooden floors. They provide a good, clean place for washing carriages or automobiles, and they do away with a mudhole near the barn or garage.

Size—Build the floor big enough to take not only the wheels of the rig but the shafts or tongue as well. Make it large enough to give the person who does the washing room to work on. The average size is about 12 feet square.

Construction—The concrete should be 5 inches thick throughout. Slope the earth each way toward the center and provide a drain—otherwise the water will run off the sides, taking with it the dirt from the vehicle. A convenient way to build a drain is to excavate, directly in the center, a hole big enough for a large sized barrel. Knock out the bottom of the barrel, set it in the hole, and fill it with field stones. If the soil is clayey so that the water does not drain readily from the barrel, it will be necessary to run a drain from the barrel, as shown in Figure 71, to some convenient point.

Mixture—Mix the concrete in the proportions of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel. Finish with a wooden float.

Quantities required—To build this 12-foot square concrete floor, you will need 13 bags of Atlas Cement, 26 cubic feet of sand and 52 cubic feet of gravel or crushed stone. It ought not to be more than a day's work for two men.

For underdrainage, see page 28.

Fig. 67—Concrete barnyard pavement, thoroughly neat and hygienic in every respect. Such a floor pays for itself in a short time in improved health of cattle.

Fig. 68—Paved barnyard with concrete trough, clean and sanitary the year round. The photograph shows plainly the construction in alternate squares with expansion joints.

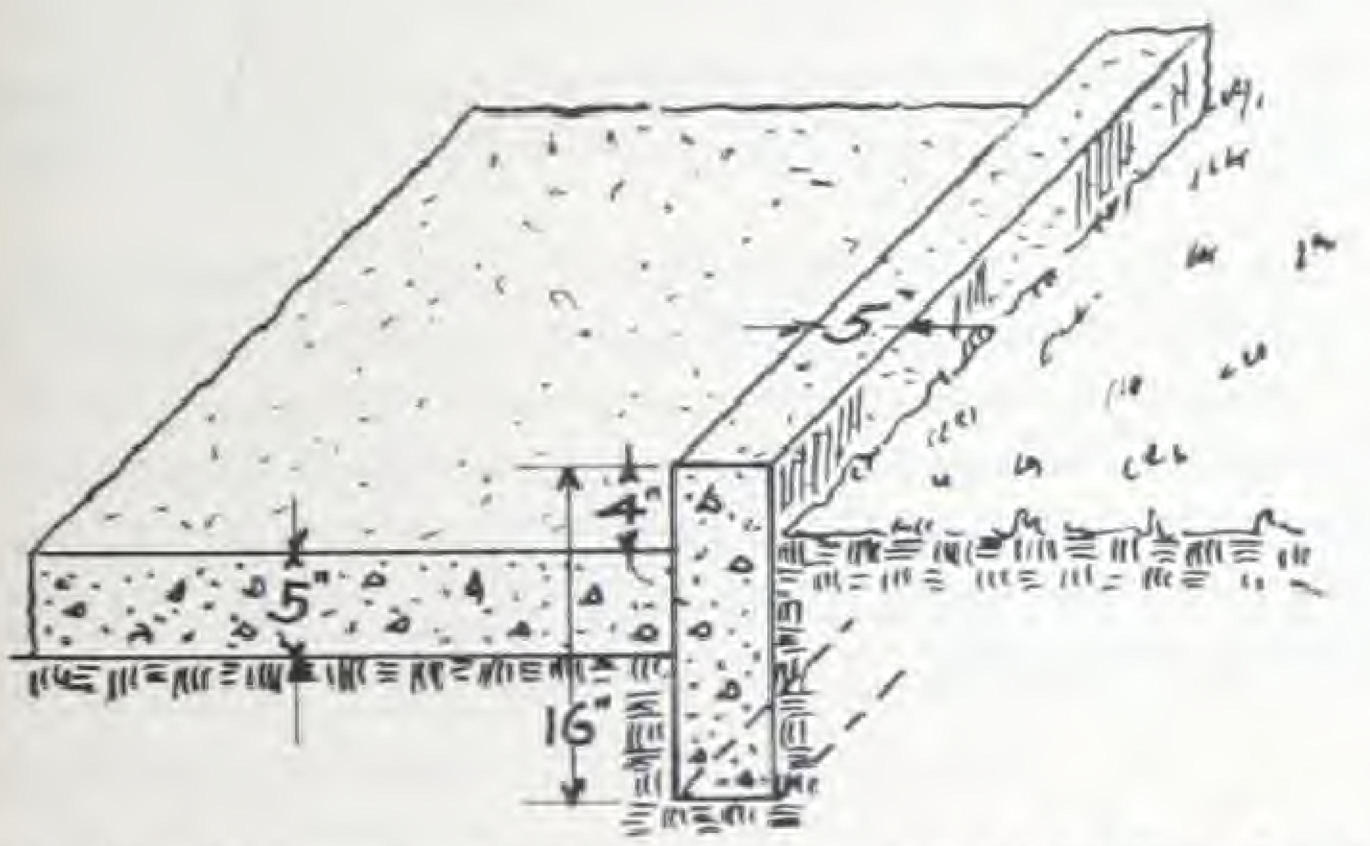


Fig. 69—Diagrams showing construction of feeding floor. At the right the apron or turndown wall to prevent hogs from rooting up the floor.

Fig. 70—Finished feeding floors of concrete.

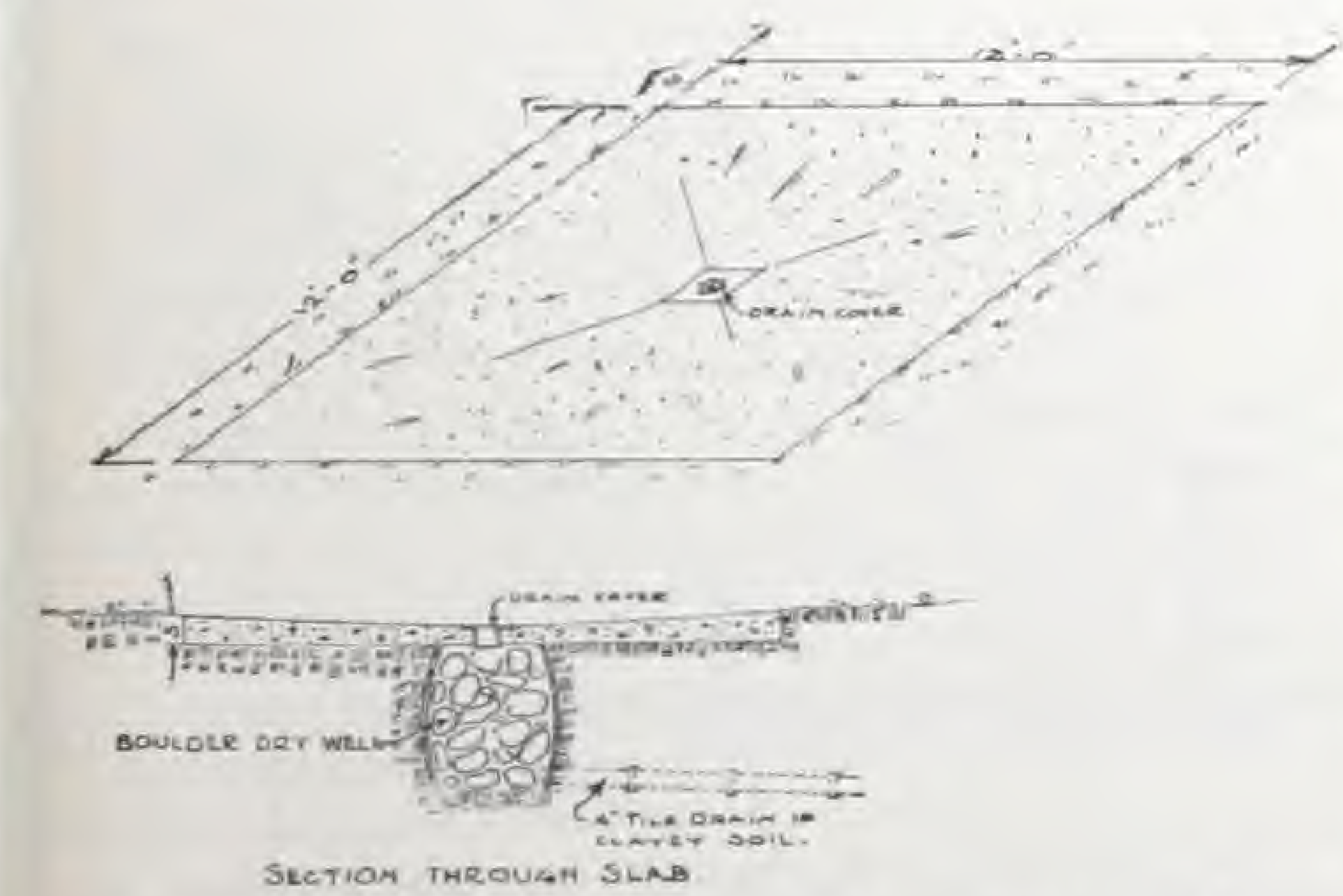


Fig. 71—Working drawing for carriage washing floor.

Fig. 72—The completed washing floor in use.

How to get expert advice on your problems—see page 19.

Curbs and gutters

Concrete is the material commonly used for curb and gutter construction. It is adaptable to any form or shape; it is low in cost, and can be built at the same time as a driveway or pavement. It wears wonderfully, being waterproof and almost timeproof.

Construction is easy

Types—There are two types—the single curb, and the combined curb and gutter. Their construction is identical, the difference being in their shape. The single curb is usually built 6 to 8 inches thick at the top, and 9 to 12 inches thick at the bottom, and 18 to 24 inches deep. The side next to the walk is vertical, and the side facing the gutter is at a slight angle—see Figure 73, which also shows how forms are constructed and braced. For dimensions of the combined curb and gutter—and the construction of forms—see Figure 74.

Excavation, forms, etc.—In constructing the curb first excavate to the required depth. Drain the soil if necessary, by excavating 8 inches more and filling in with gravel or cinders as a base. Build forms for the entire height, as shown in the drawings below, unless the earth is so firm that they need only be built for the part above ground.

Expansion joints must be provided about every 10 or 15 feet in the length of the curb. This is done by placing a board at the end of the form against which the concrete is poured. This gives a square end. Against this end place a thin piece of steel or wood or a couple of thicknesses of tar paper when the next section of the curb is poured to leave a slight opening. The steel or wood should be removed, but the tar paper can be left in place.

The mixture should be 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone with particles not larger than 1½ inches.

Quantities required—For every 100 feet length of curb, such as shown in Figure 73, using the above mixture, there will be needed 24 bags of Atlas Cement, 48 cubic feet of sand, and 96 feet of gravel or crushed stone. For the same length of curb and gutter, made as in Figure 74, you will need 30 bags Atlas Cement, 60 cubic feet of sand, and 120 cubic feet of gravel or crushed stone.

Note—Two-course construction for curbs was formerly the customary construction, but there is a general tendency at the present time toward one-course work—the same mixture throughout. It is easier and cheaper to handle. By properly tamping and spading the concrete and then removing the forms as soon as possible and troweling the surface, you will obtain a good finish.

Fig. 73—Forms, bracing and dimensions for single curb.

Fig. 74—Forms for combined curb and gutter.

Read pages 87 to 91 on better roads.

Fig. 75—A small concrete milk house.

Fig. 76—A convenient milk house adjacent to cow barn.

Dairy and milk houses

A dairy or milk house should be built so that it can be cleaned easily and kept free from decaying material of any kind; its walls and floors should contain no cracks that will hold vermin or refuse. City and State health authorities are becoming more rigid in their rules how milk should be handled. The wise dairy farmer sees the importance of having good sanitation—even better than the law requires.

Dairy experts are enthusiastic about concrete. If you build your foundation, floor, cooling tank, and walls all of concrete, you will have a thoroughly sanitary, permanent structure.

The design of such a house is simple. It can be easily built and is reasonable in first cost—sometimes even lower than wood—and costs nothing for upkeep, painting, or repairs.

Location—Build your dairy house *convenient to the barn* and along a driveway, if practical. But keep it entirely separate—even if it is built next to the barn. See Figures 76 and 78. Avoid building the dairy house too close to hog pens or manure pits, etc. The north side of the barn is a good location if it is feasible, because the barn will afford a certain amount of protection against the sun. All these points should be considered and the house located accordingly.

The dairy house should be used for nothing besides the handling of milk. It should contain a cooling tank and may have a cream separator. The larger dairy houses have an ice house adjacent with a refrigerating room built in the section of the ice house. They may also contain larger working spaces, such as rooms for making butter, etc.

How to build in concrete

Construction—The house may be built of monolithic concrete or of concrete blocks. Either method is good. When concrete blocks are used, plaster the interior with cement mortar (see page 17, paragraphs 90-93) to provide a smooth, even surface free from cracks.

Let us consider a house 10 by 12 feet inside dimensions (see Figure 77). The first thing to do is to excavate to a depth of 3 feet and construct a good foundation. The building of foundations has already been taken up in detail on page 13, and what has been written about the construction of foundations in general applies in this instance. For a house this size, build the foundations 10 inches thick, of 1 part Atlas Cement, 2½ parts sand, and 5 parts gravel or crushed stone.

Floor—The floor may be laid directly on the ground, but be sure to have the soil well packed down and thoroughly drained, if draining is necessary. If you have to fill, in order to secure the desired level, have the material well tamped. Level the floor carefully. Lay a concrete floor 4 inches thick of a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. One-course concrete will be suitable, and it will save the expense of putting on a finish coat. Further information on floors may be found on pages 30 and following.

Walls—Walls should be 6 inches thick for a house of this size. For wall forms see page 13. Put window frames in their proper places during construction of the wall and reinforce the concrete over these openings with two 1-inch diameter rods placed 2 inches above the opening. Reinforcement is needed above all openings.

Use a concrete mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. You will have

On other small farm buildings, see page 42.

to use buckets or wheelbarrows to handle the concrete. If you are going to use wheelbarrows, you should build, first of all, scaffolds around the wall forms and construct runways, at least 20 inches wide, with the boards lapped in the proper direction for easy wheeling of the loaded barrows. After the concrete has been mixed, it can be put in wheelbarrows, wheeled up the runway and then dumped into the forms.

When the mix is placed in the forms it should be well spaded on both the inside and outside, to work the larger stones away from the surface and to bring the sand and cement next to the form, thus providing an even finish. After the forms are removed, the wall may be treated by rubbing it with a concrete brick or carborundum stone. Sometimes the walls are left in the condition they are in when the forms are removed, and if the forms have been tight and evenly built, and the concrete well spaded, the appearance of the surface is satisfactory without any further treatment.

The cooling tank in Figure 77 is 2 feet 6 inches wide, 1 fo 8 inches deep, 9 feet 4 inches long, inside measurements. I walls are all 4 inches thick. The bottom is 6 inches thic The concrete is a mixture of 1 part Atlas Cement, 2 par sand and 4 parts gravel. Building concrete tanks is a subje in itself, and is treated on page 58. This tank will hold cans, each 14 inches in diameter. Either concrete or wood partitions may be used to separate the tank into compar ments.

The quantities of materials for this all-concrete dairy hou with the dimensions given, are: 96 bags of Atlas Cemen 200 cubic feet of sand, 400 cubic feet of gravel, and for re inforcement: 25 rods, ⅜ inch in diameter, and 12 feet, inches long; 8 rods, ⅜ inch diameter and 14 feet, 6 inche long; 6 rods, 1-inch diameter and 6 feet long; and 2 rod 1-inch diameter, and 4 feet, 6 inches long.

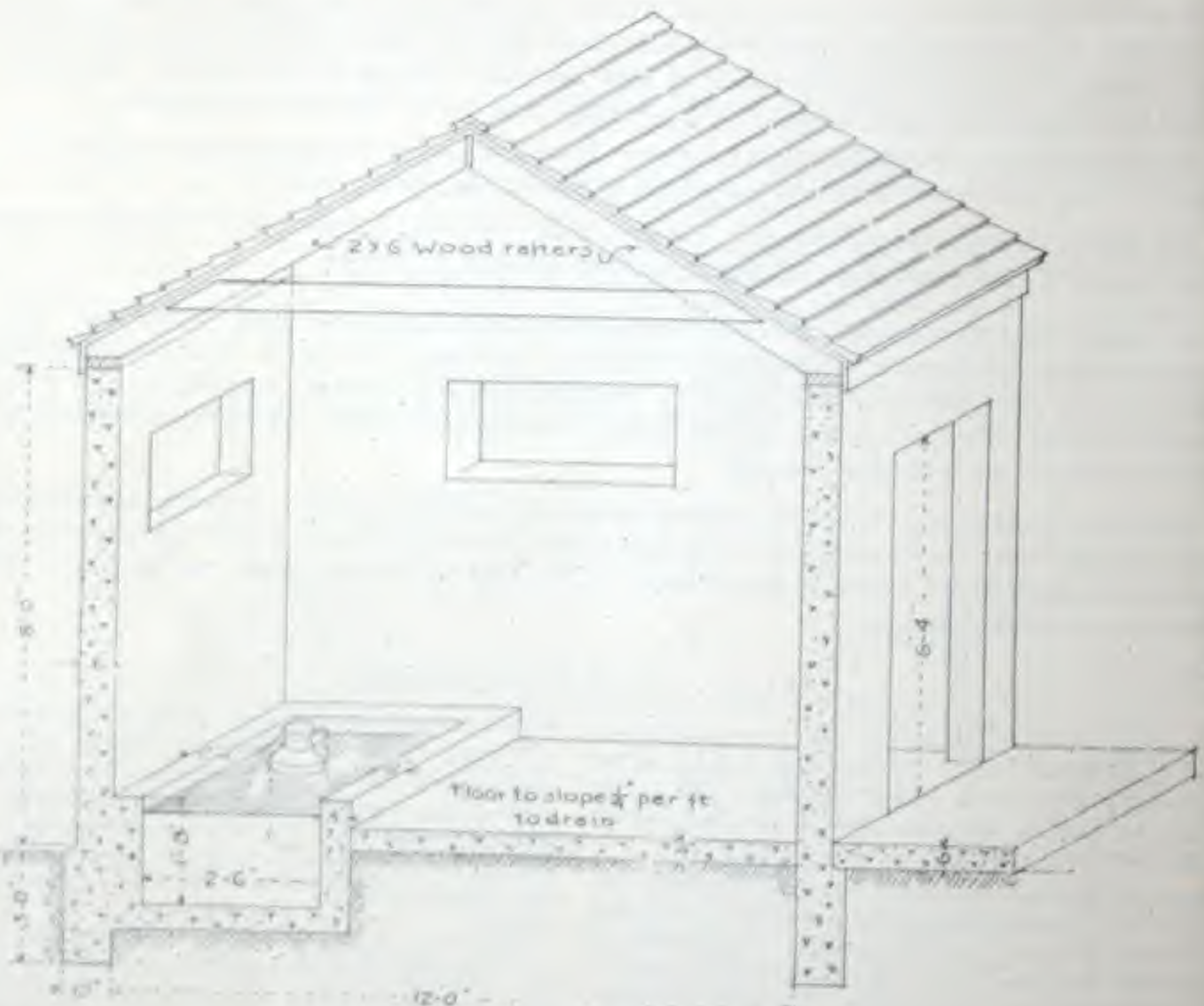


Fig. 77—A model milk house, measuring 10 by 12 feet. It has concrete foundations, floors, walls, cooling tank and step slab, with a wooden roof.

For placing concrete, see page 11.

Fig. 78—A small concrete milk house with pent-house, concrete step slab, and wooden roof.

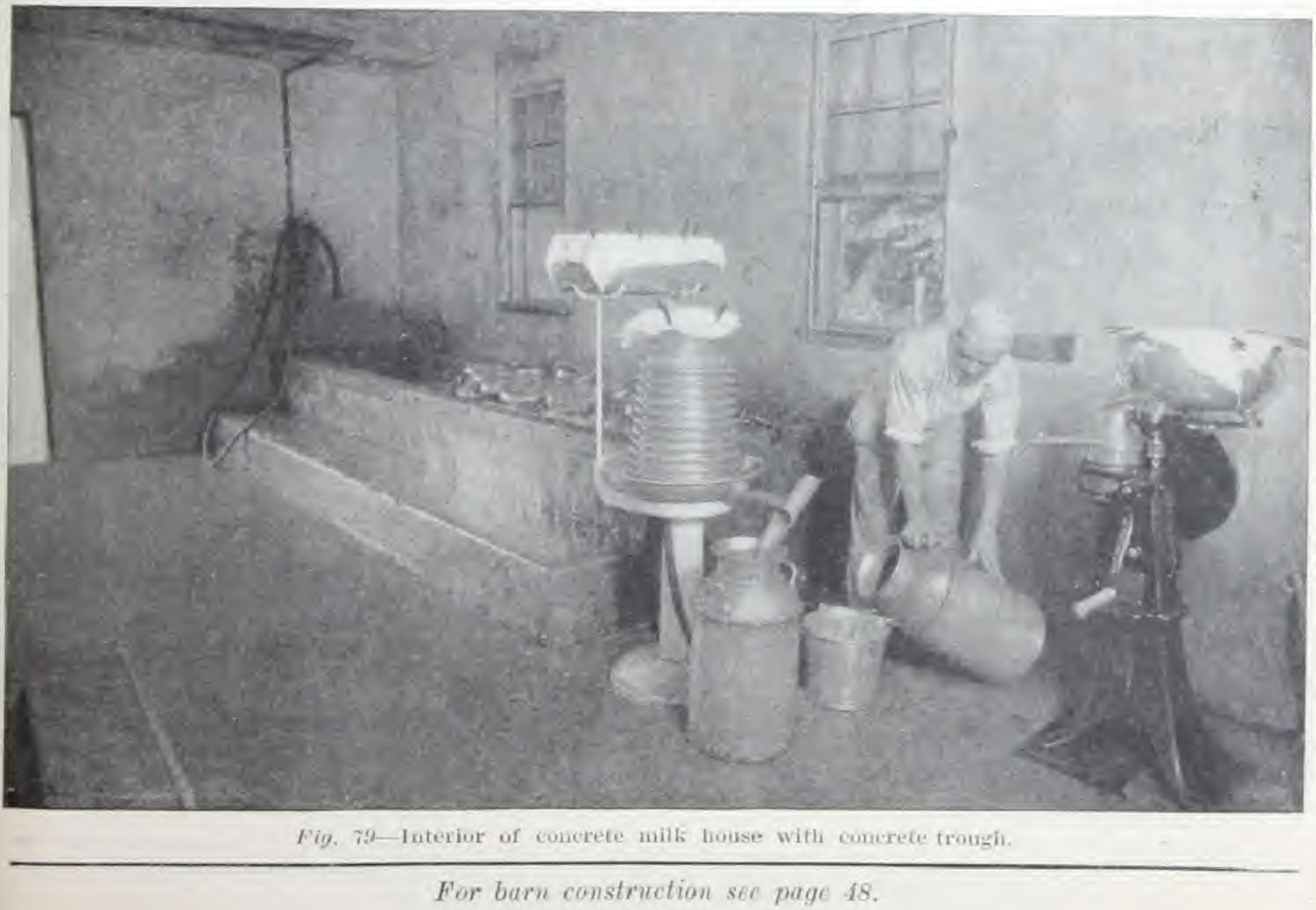


Fig. 79—Interior of concrete milk house with concrete trough.

For barn construction see page 48.

Small buildings for the farm

Smoke houses, hydraulic ram houses, pump houses, acetylene gas plant houses, tool houses, coal houses, gasolene engine houses

There are a number of small farm buildings that may be listed together here—all best built of concrete.

A smoke house should be proof against fire, and for this reason concrete is most suitable.

Hydraulic ram houses and pump houses have to be near to springs or wells, so that they rot quickly if they are constructed of wood. Some durable material is needed which will not require repair or deteriorate in any way. Concrete should therefore be used.

For acetylene gas plant houses concrete is used because it is fireproof and permanent.

For other small farm buildings, such as tool houses, coal houses and gasolene engine houses—concrete is certainly the best material to use for the foundations and floors. Sometimes wood can be employed to better advantage for the walls and prepared roofing of some kind may be used to good purpose for the roof.

The general method of constructing these buildings is according to the principles previously described. They are all easily built from the general instructions already given under forms (page 13), foundations (page 20), roofs (page 15), floors (page 32) and milk houses (page 39).

You will note in the illustrations here and elsewhere that quite a few buildings are of concrete block construction. This is a simple method and very often is chosen because the blocks can be built in spare time—on bad days—by installing a simple block-making machine in the cellar. Another frequent use of concrete blocks is in home construction for the first few feet, just above the ground level. Page 80 explains in brief the manufacture of concrete blocks.

Fig. 80—Farm garage and concrete power house built of concrete blocks. The garage has a concrete slab approach.

Fig. 81—Concrete milk cooler room with arch roof.

Fig. 82—Pump house of concrete.

Fig. 83—Concrete engine house

Fig. 84—Concrete block power house and farm scales.

Fig. 85—Concrete block box for hydraulic ram with wall built of spaced concrete blocks on heavy block foundation.

For expert advice on your problems, see page 19.

Fig. 86—A very well-built concrete chicken house. This construction is almost ideal for large poultry farms. It is not as cheap for small farms as the part-wood construction shown on the next page.

Concrete for chicken houses

In planning your poultry house you should first consider where you will build it.

The place must be thoroughly dry, because dampness causes more poultry diseases than anything else does.

If the site that you have selected for the house is not dry it should be made so either by filling or putting in drains. The most desirable location would be on a slope toward the south.

Fowls are particularly susceptible to ill effects of bad air. A noted authority says "200 five-pound hens, while weighing approximately the same as a cow or horse, will breath from 2½ to 3 times as much air in the same length of time." Hence every provision should be made for giving proper ventilation and furnishing an adequate supply of fresh air, but air should be admitted in such a way that no draughts will be produced. The desired ventilation is easily provided by the open-front type of poultry house. This has several modifications and has been practically adopted as standard. The open-front house is tightly enclosed on all sides except the south, towards which the house faces. The south side is constructed so that it is practically open to the fresh air. The openings are covered with muslin or cheese cloth which provides free ventilation without draughts and excludes cold damp winds.

By facing the house toward the south you secure maximum of sunlight. Sunlight is an efficient aid in the destruction of disease germs, and the heat that is carried with the sun's rays is very desirable.

How to build chicken houses

Figure 87 shows a standard poultry house, constructed in the most economical manner. It has a concrete foundation, wooden walls and roof and open side. Figure 86 is all-concrete—an ideal construction for an elaborate poultry farm. Fig. 88 has all-stucco walls with wooden roof.

Floor—From 2 to 5 square feet of floor space should be allowed for each bird. Some poultrymen desire only dirt or gravel floor where the house is raised above the level of the surrounding ground and where it will at all times of the year be perfectly dry. Others desire tight board floor well littered with straw, and some find conditions more clean and sanitary where the floor is constructed of concrete and kept covered with straw or sawdust. A floor constructed in this manner prevents harboring of rats or other vermin.

The house itself may be constructed of any durable lumber available—or in part of concrete, as in Figures 87 and 89. For studding, 2-by-4's can be used. For roof rafters use 2-by-4's or 2-by-6's, depending upon the size of the house. The details shown on the opposite page explain the arrangement and construction.

The roof is a very important part of the house and must be water-tight. Shingles or tar-paper may be used. Shingled roofs are warmer in winter and cooler in summer than those constructed of other types of roofing material.

The roosts, dropping boards and nests are placed in the back of the house. Protect them during severe winter weather by muslin or duck curtains hanging from the roof to within one foot of the floor.

Painting adds much to the appearance and to the service of a chicken house. Ready mixed paints can be secured so that painting is an easy job. Whitewashing the interior of the house adds to its appearance and is a great assistance in keeping the house clean, fresh and sanitary. An excellent whitewash disinfectant can be made as follows:

Mix: 1 peck unslacked lime.
2 lbs. common coarse salt.
1 gal. crude carbolic acid—dilute to 40 gal. with water.

For drainage under floors and pavements, see page 28.

ig. 87—Wooden poultry house on concrete foundation.

Fig. 88—A handsome stucco poultry house.

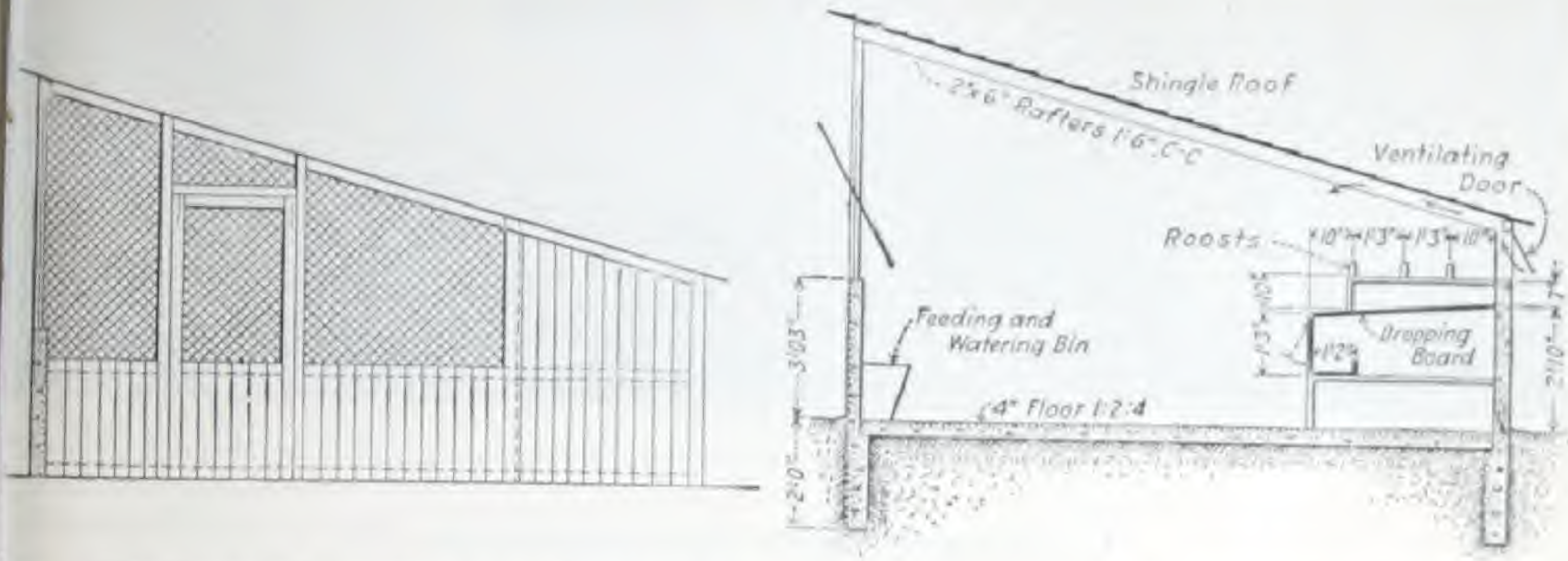


Fig. 89—Above—to left—partition in model chicken house;—to right—foundation, floor, walls, roof, roosts, nests, etc.

Fig. 90—Different types of chicken house roofs: A as in Figs. 86, 87 and 88—probably the best type.

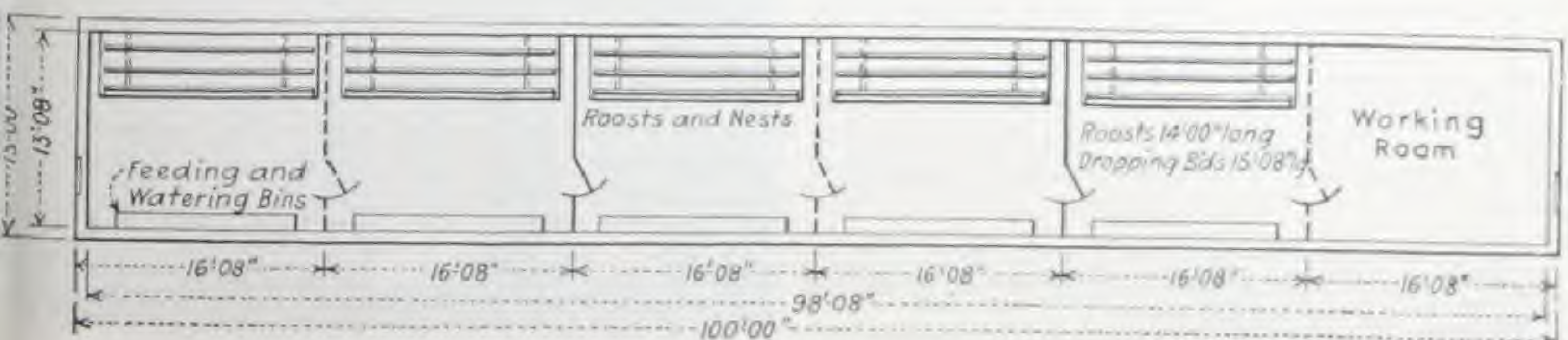


Fig. 91—Floor plan for chicken house with five rooms for fowls and a work room.

Forms for roofs are described on page 15.

Fig. 92—A well constructed concrete greenhouse, with shed roof, built against a concrete retaining wall.

Concrete for greenhouses

Greenhouses should be constructed of a material that will require little or no repairs, and that will keep the air inside warm and moist during the severest winter weather. The use of concrete means a good permanent structure, with little danger of fungus growth or bad conditions of heat and moisture.

How to build

Construction—The thickness of the *foundation* depends upon the dimensions of the building. Under ordinary conditions, a foundation wall 10 inches thick will prove sufficient. It must be deep enough to extend below the frost line. The foundation concrete should be a mixture of 1 part Atlas Cement, 2½ parts sand, 5 parts gravel or crushed stone. Forms and construction of the foundations are described on pages 13 and 20.

For ordinary greenhouse *walls*, 6 inches is the proper thickness. Use a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. When the concrete is poured, bolts should be set vertically (as in Figure 24, page 21), about 2 feet apart to allow the steel or wooden framework as the case may be, to be fastened securely to the concrete walls.

Figure 92 shows the exterior of a greenhouse. The interior view of another greenhouse, Figure 93, shows the arrangement of alley-ways and beds.

The concrete *curbing* shown, which holds the earth in place for the beds, is 6 inches thick and 1 foot above ground, and 2 feet below. The construction of this curb is the same as for an ordinary wall; use a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

To figure the quantities of cement sand and gravel necessary to build a greenhouse, figure separately the amounts for foundations and walls (see page 20), and curbs (see page 38).

Fig. 92b—Concrete trays for the greenhouse are easily made and are neat and clean.

Fig. 93—Interior of a concrete greenhouse with concrete curbs for walks and plant beds.

Hot beds and cold frames

Hot beds and cold frames are used to provide vegetables out of season and to rear early spring plants ot beds are set into the ground, with a flat sloping cover, all of glass.

The hot bed should be located where it will receive as much sun as possible, and face the south or south-st in the Northern States.

Simple to construct

Construction—First, dig out the bed below frost line. Then ild forms for a wall 4 inches thick, as described on page 13. se a concrete mixture of 1 part Atlas Cement, 2½ parts sand d 5 parts gravel or crushed stone. The front wall—on the uth side—should be 6 inches above the ground surface vel. The height of the back wall depends upon the location the bed, and the slope of the glass desired to catch the eatest amount of the direct sun rays.

When concrete is poured, place bolts vertically at 2-foot intervals (see Figure 24, page 21) to fasten the frames on top securely to the concrete walls.

Hot house frames are made especially for these constructions, but an old window sash may be used. If you want to build a hot bed at low cost, use a window sash you have and build the concrete walls to conform to it.

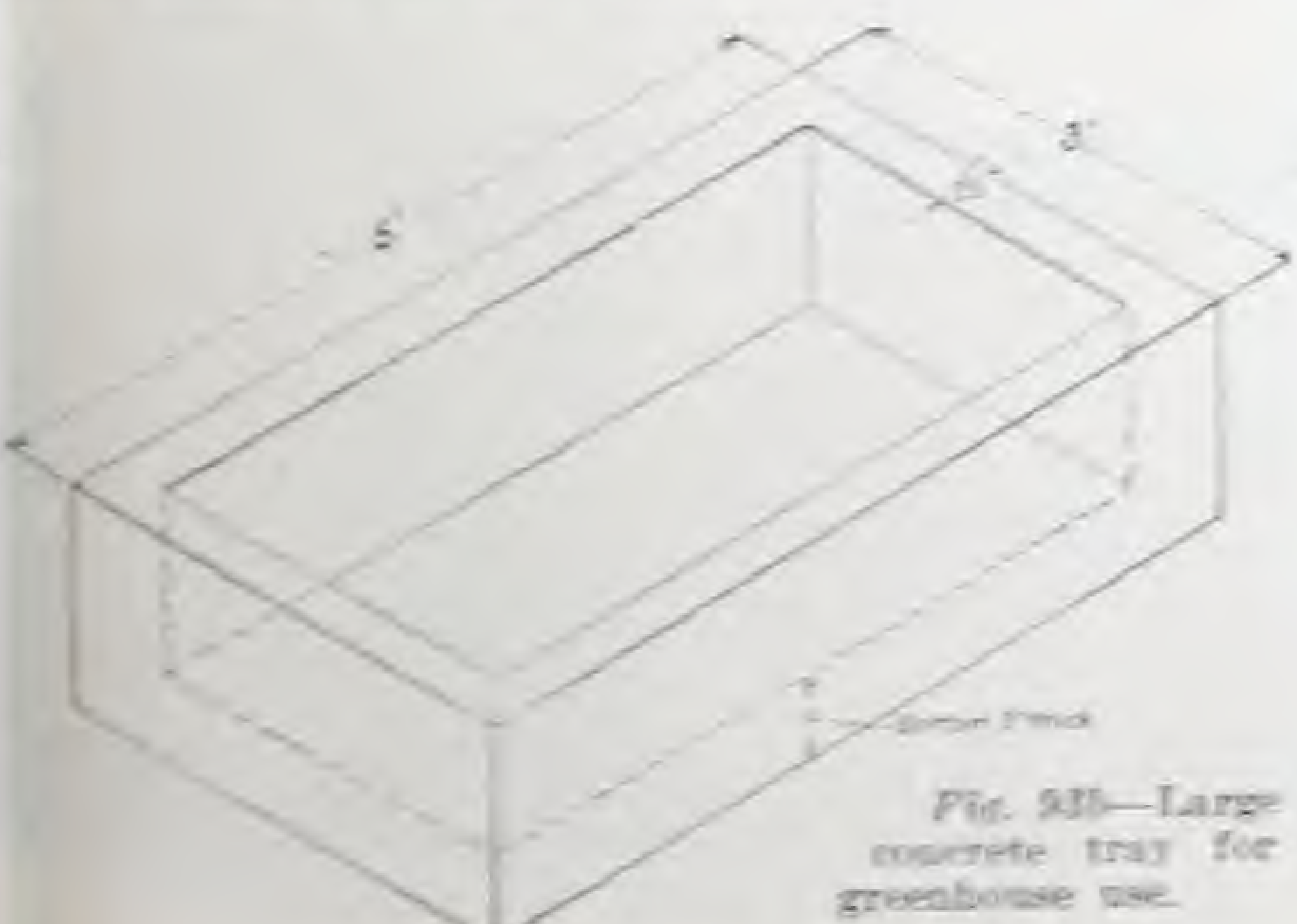


Fig. 93b—Large concrete tray for greenhouse use.

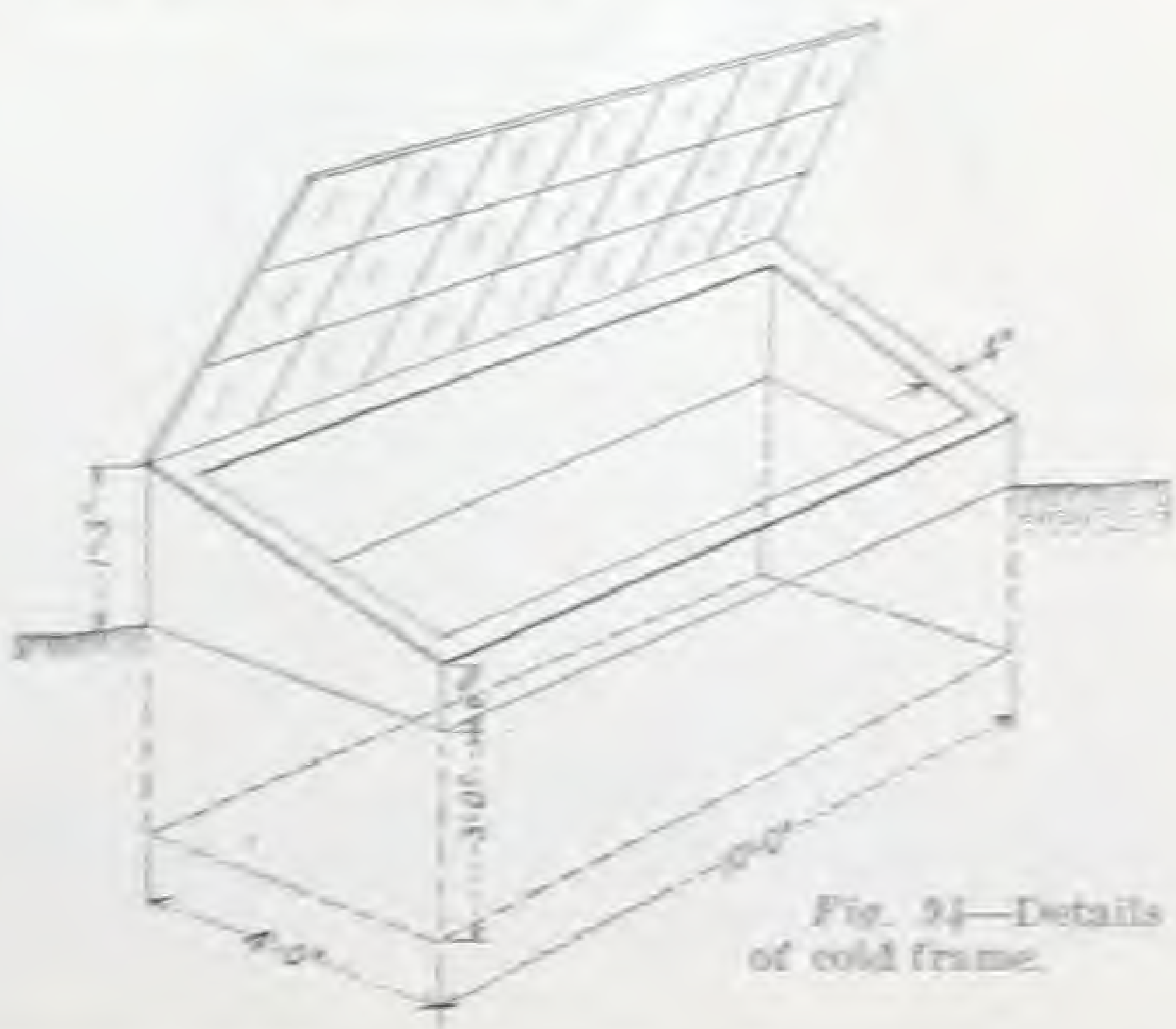


Fig. 94—Details of cold frame.

Easy rules for figuring quantities of materials are given on pages 8 and 9.

Fig. 95—First story concrete barn—a construction that makes it possible to build an all-concrete barn gradually—and to have some of its advantages in the meantime.

Fig. 96—A barn built of concrete to the eaves—a m stage between Fig. 95 and the all-concrete barn This gives the greatest possible safety in construction *without* a fire-proof roof.

Concrete in barn construction

The construction of barn foundations and floors of concrete has been explained on page 30. The use concrete for the construction of the barn superstructure—at least up to the hay floor-level—has advantag

The concrete barn has many advantages over an all-wood structure for it is far more sanitary—having no wood to absorb odors or moisture. It is warm in the winter and cool in the summer. And it is a permanent fire-proof structure that has no painting or other upkeep charges, and does not rot or decay.

The model barn, with several different floor plans shown on the opposite page is designed to be constructed with foundations, floors and side-walls of concrete and the roof of wood.

The floor plans for the model barn of concrete are only suggestions of arrangement. You will note that the typical plan is designed more especially for the dairy barn while the four smaller plans show how the one building can be divided to serve quite as well for a general utility barn on smaller farms where there are horses, cattle and carriages to stored, together with one or two milch cows.

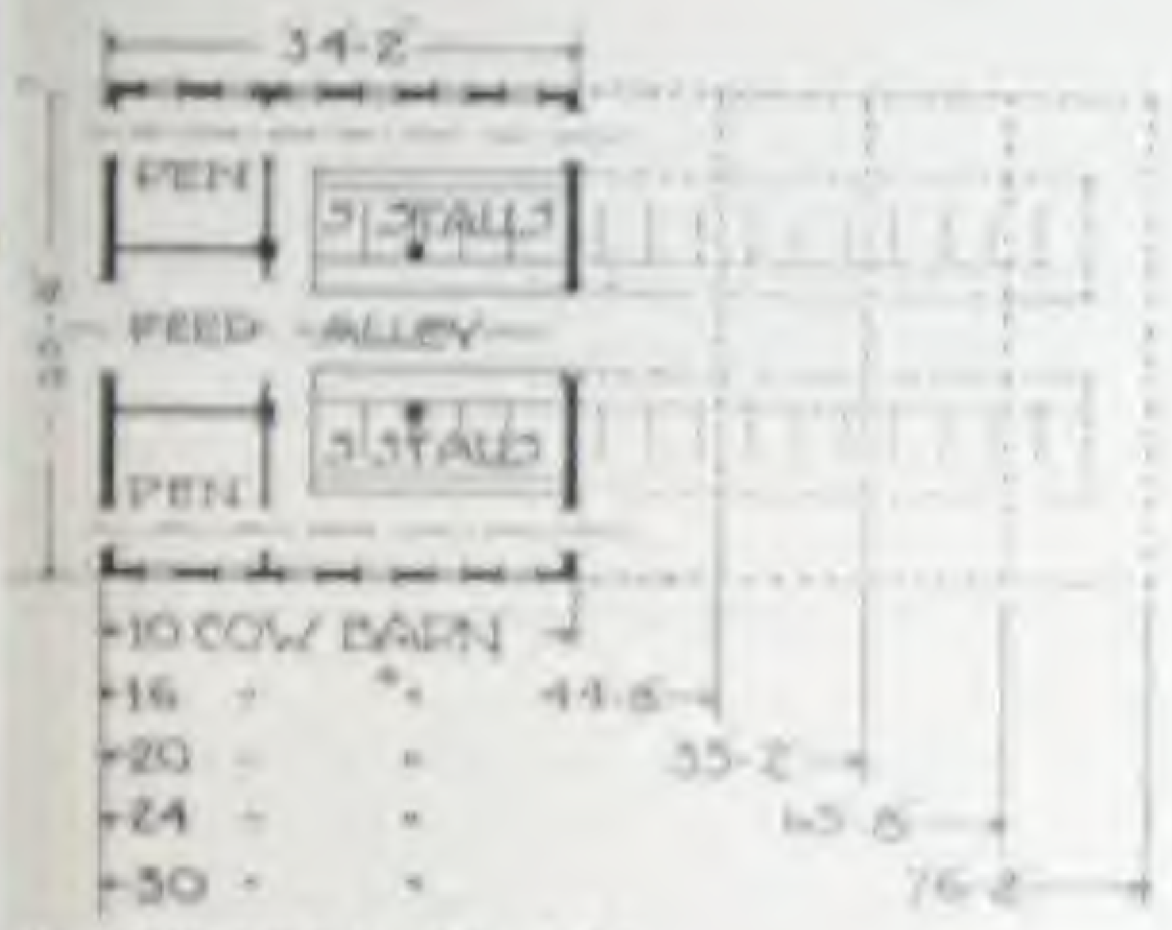
Proper design for a concrete structure of this size is essen for success. This is a job for an engineer or an architec especially if you are building a good sized barn. Get exp advice on design—from a local engineer, architect or c tractor.

We will furnish further information to meet your partic requirements, if you will tell us the number of your hor cattle and whatever else you want to house, such as wag implements, etc. Write to the Atlas Technical Depa ment. See page 19.

Fig. 97—Reinforced concrete barn, dairy and silo. Main building, 31 by 38 feet. Cow barn 50 by 38 feet.

Fig. 98—Barn at Vineland, N. J. Training School—a well constructed frame building which burned down in a single hour.

Fig. 99—New concrete fireproof barn at Vineland, replacing one shown in Fig. 98. Note advantages of concrete pavement (at left) over flagging (at right).



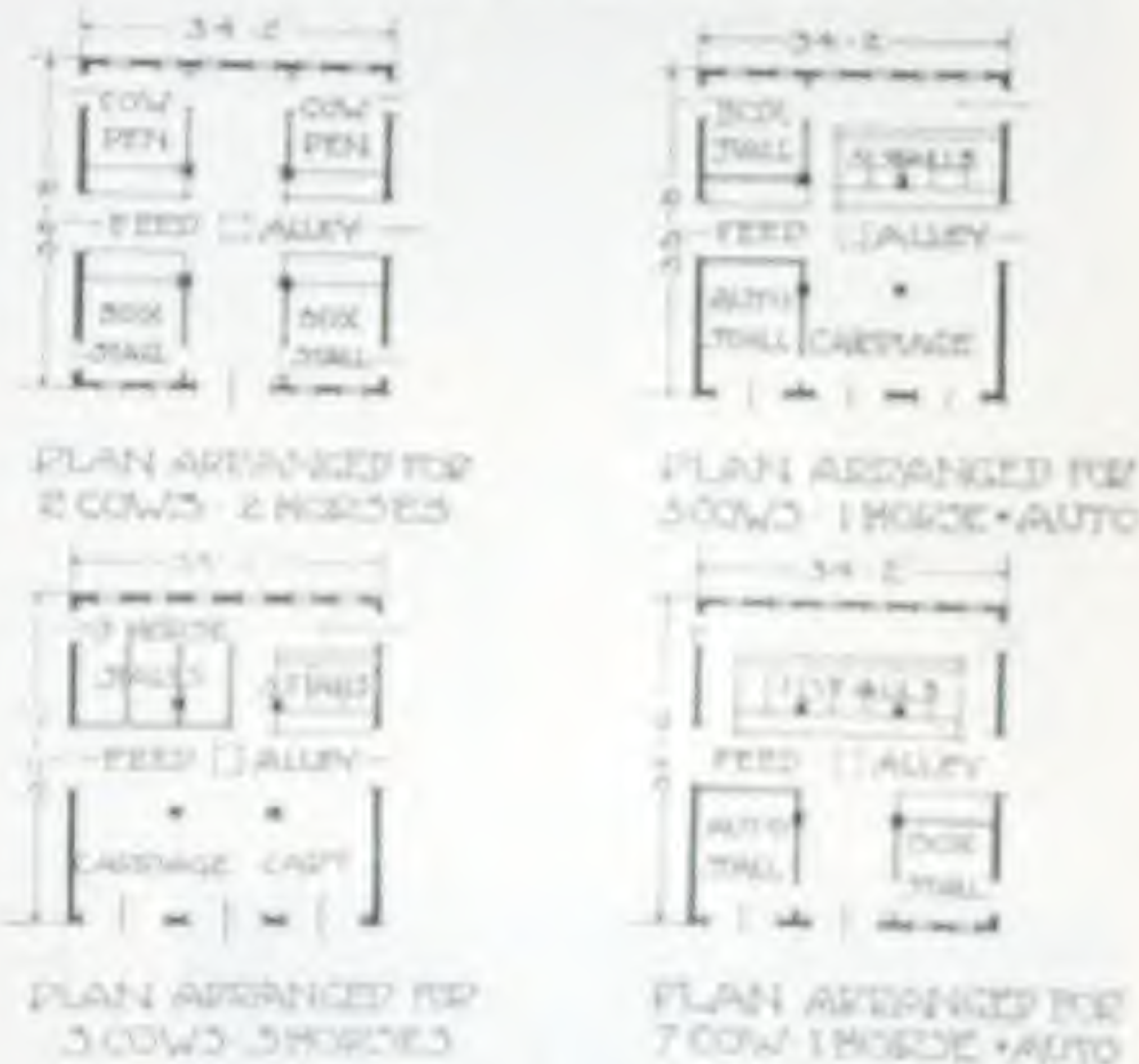


Fig. 100—Above and to the right model plans for layout of barn for different stock requirements. The drawing immediately above shows how this unit of construction can be made the basis for a growing barn to fit the growing needs of the farmer.

Fig. 101—A simply designed and very efficient concrete barn.

Concrete for the corn crib

Fig. 103—Corn crib with concrete foundation and floor—a partial protection against rats and foundation and sill decay.

Fig. 102—Detail for construction of concrete foundation and floor for corn crib.

Fig. 102b—Interior view of corn crib with walls of hollow tile.

An important structure on the farm is the storage place for drying corn. The corn crib, as it is usually built, is the rat headquarters of the whole farm. The waste caused each year by rats and mice in corn cribs is enormous. By raising the crib a few feet on concrete piers, you will put one big obstacle in the way of the rats. A second important step toward conservation will be taken if you will build the floor also of concrete and this will make a much more permanent structure, and far less likely to catch fire.

Easily built

Piers—The piers upon which the crib is placed should extend underground below the frost line. Each pier should rest upon a base or footing at least two feet square and one foot thick. The mixture for these is 1 part Atlas Cement, 2½ parts sand, and 5 parts gravel or crushed stone. See pages 22–23 on the construction of piers and page 14 on forms for piers and foundations.

Under ordinary conditions, piers 8 inches in diameter, extending 18 inches below the ground and 30 inches above, are satisfactory. Including footing, 5 2-5 cubic feet of concrete will be required for each pier, that is 1 bag of Atlas Cement, 2½ cubic feet of sand, 5 cubic feet of gravel or crushed stone.

Figures 102 and 103 show an alternative construction with solid walls instead of piers, the walls being 8 inches thick.

Figure 102 shows how to construct a concrete floor and trench—the base and sides of which should be constructed (framed and poured) before work is begun on the main floor of the crib.

If you build the floor of concrete, make it 5 inches thick throughout.

Take every precaution to get a solid foundation. If the ground is not firm, dig deeper and fill the extra excavation with cinders or gravel packed to make a firm base.

See page 20 on building foundations and pages 30 and following for floor construction.

If the side walls are of wood, as in Fig. 103, they should not be placed upon the piers or foundation walls for at least ten days after pouring.

Fig. 102b shows a good construction for a corn crib. It has concrete floors and the side walls are of hollow concrete tile turned horizontally.

For general instructions on small buildings see page 42 and page 39.

Fig. 104—Twin circular silos of monolithic concrete built against a frame barn.

Why you should have a concrete silo

A silo is indispensable to efficient farming. The experience of the last thirty years has demonstrated beyond doubt that both milk and meat can be produced more cheaply by feeding ensilage.

The silage crop is harvested at the proper stage of maturity and this green feed can be preserved in the silo for feeding during the cold winter months or through the droughts of summer. With a properly constructed silo the preservation of the silage may be so complete that the ensilage will keep from year to year or even for several years.

Fig. 105—Showing small machine mixer, block and tackle and forms for building silo or large tank.

It has been said that the ideal silo would be a glass fruit jar, because it has smooth airtight and watertight walls without joints. Silos built of concrete fulfill these requirements. They are vermin-proof, rust-proof, decay-proof, and fire-proof. They are recommended by government authorities and may be very economically constructed.

There are several different kinds of concrete silos: the monolithic or one-piece silos, the concrete block, the concrete stave, the stucco, and the pit silo. The construction will not be discussed here because we have a very complete book on the subject which we will be glad to send you on request.

The first cost of a concrete silo is practically the whole cost. In the construction of a solid concrete silo first cost ranges from $2.00 to $3.50 per ton capacity. The average is about $2.50.

The table below and that on page 52 give silo capacities and herd silage requirements, etc.

Capacity of silos in terms of stock to feed

Diameter of Silo.	Average Daily Feed.	Number of Animals to be Fed from each Size Silo.					
		Horses.	500-lb. Calves.	Stock Cattle.	Beef Cattle.	Dairy Cows.	Sheep.
10 feet	525 lbs.	48	44	26	21	13	175
12 "	755 "	69	63	38	30	19	252
14 "	1030 "	94	86	52	41	26	344
16 "	1340 "	122	112	67	54	34	446
18 "	1700 "	155	142	85	68	42	567
20 "	2100 "	191	175	105	84	53	700

Fig. 106—A concrete block silo and a frame barn.

Fig. 107—Filling a concrete silo with corn stalks.

Silage requirements of different size herds

This table gives the number of cows in herd and tonnage of silage for both 180 and 240 days of feeding of 40 pounds of silage per cow; also acreage of corn estimated to fill the silo and the dimensions of the silo itself. The diameters given are such that at least 2 inches in depth of silage will be taken off daily.

An acre of land gives about 1 ton of silage for every 5 bushels of corn. If an acre yields 80 bushels, it will produce about 16 tons of silage. This table is based on a yield of 50 bushels or 10 tons of silage per acre.

Size of Herd.	Feed for 180 Days.				Feed for 240 Days.			
	Estimated Tonnage of Silage Consumed.	Size of Silo.		Corn Acreage Required at 10 Tons to Acre.	Estimated Tonnage of Silage Consumed.	Size of Silo.		Corn Acreage Required at 10 Tons to Acre.
		Diameter.	Height.			Diameter.	Height.	
10 Cows	36 Tons	10 Feet	25 Feet	3½ Acres	48 Tons	10 Feet	31 Feet	5 Acres
12 "	43 "	10 "	20 "	4½ "	57 "	10 "	35 "	5 "
15 "	54 "	29 "	29 "	5½ "	72 "	11 "	36 "	7½ "
20 "	72 "	12 "	32 "	7 "	96 "	12 "	39 "	10 "
25 "	90 "	13 "	33 "	93 "	123 "	14 "	37 "	12½ "
30 "	108 "	14 "	11 "	11 "	144 "	15 "	37 "	14½ "
35 "	126 "	15 "	13 "	13 "	168 "	16 "	38 "	17 "
40 "	144 "	16 "	35 "	14½ "	192 "	17 "	39 "	19½ "
45 "	102 "	16 "	37 "	16½ "	216 "	18 "	39 "	22 "
50 "	180 "	17 "	37 "	18 "	240 "	19 "	39 "	24 "
60 "	216 "	18 "	39 "	22 "	288 "	20 "	40 "	29 "
70 "	252 "	19 "	40 "	25½ "	336 "	23 "	46 "	34 "

Ask a local contractor to figure your silo job.

Fig. 108—A concrete hog house, combined with a two-story general utility shed.

Sanitary hog houses of concrete

Hog raising has become very profitable for the farmer. It has been developed almost to an exact science, of which proper housing is a vital part. Early pigs bring the high prices and if you have a warm concrete house you can safely raise a February or March litter.

A concrete hog house can be made almost proof against hog cholera or other diseases. It is easy to clean—especially if all the corners are rounded—and the pens can be swept clean with water, flushed out with a hose, and easily disinfected.

The hog house should be on a well-drained site and should be built with the feed alley running east and west so that the sun windows in the roof will face south and get the direct winter sun. The hog house should be so situated as to give direct access to the pastures—then the building can be used all the year round, for farrowing and for care of the young pigs in the late winter and spring, for feeding and shelter during the summer, and for fattening in the early autumn.

Foundation—The foundations are usually 10 inches thick and should be carried below the frost lines, and if the earth is firm, the foundation trench can be filled with concrete up to the grade without the use of forms. Follow instructions on foundation forms in paragraphs 64-70, page 13.

The walls above the foundation should be 8 inches thick and 3 feet 6 inches high.

The partition walls forming the pens are of the same height as the outside walls, but are only 6 inches thick. These need only a small footing just below the level of the floor. The forms for these partition walls are the same as those for the outside walls.

After the walls are built the floors should be constructed, and these can be made 5 inches thick of a mixture 1 part Atlas Cement, 2 parts sand, and 4 parts stone.

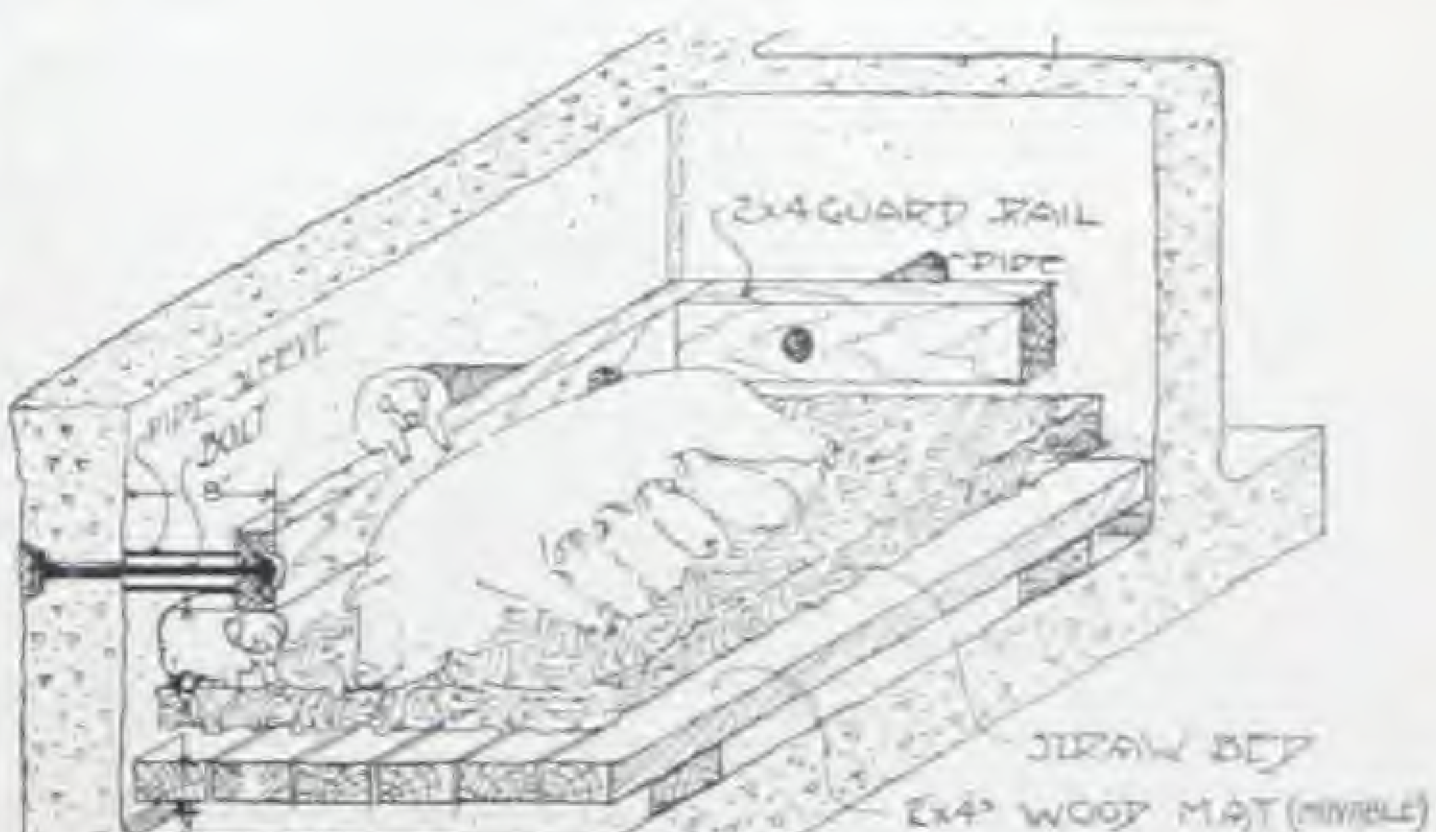


Fig. 109—Sow's nest, showing protection for young pigs.

How to build hog wallows, see page 65; hog troughs, see page 72.

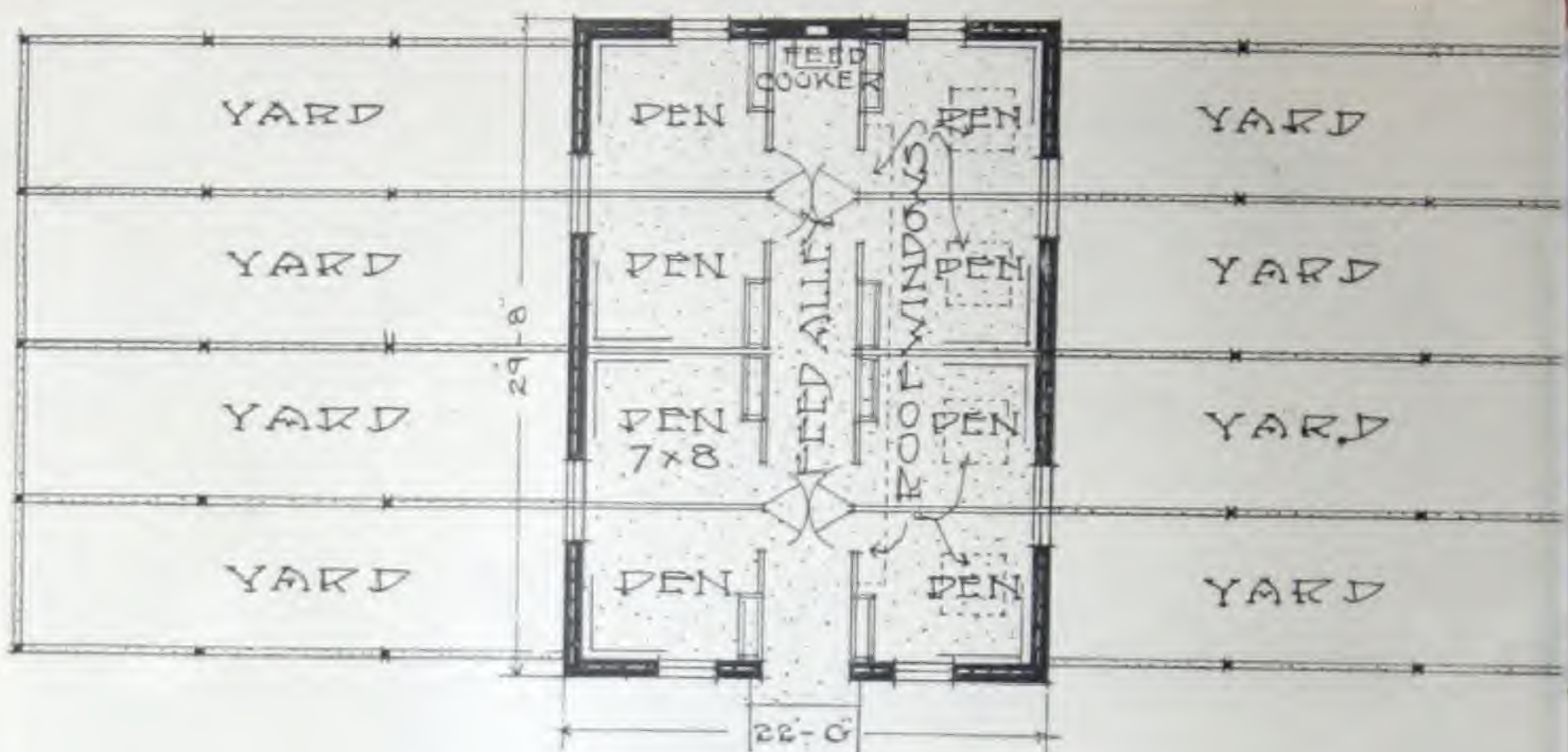


Fig. 110—Floor plan of model hog house.

Fig. 111—Section of model hog house showing partition walls, feeding troughs, gutters, etc.

General information on pavements and floors, page 28.

The pens should slope from the outside wall toward the alley way down the center, and small openings should be left through the walls so that the pens can be easily drained when they are flushed out. The alley way should have small gutters along each side.

Two doors are made in the walls of each pen, one leading to the alley way and one from the other side of the pen to the yard.

Although concrete floors have proved entirely satisfactory for pens where bedding is used, some prefer to inlay cork, brick, or asphalt blocks in the corner of the pen when the sow makes her nest. Sometimes a movable wood mat is made of 2-by-4's, and the bedding is placed on this. This method is shown in Figure 109. A guard rail should be installed on both sides of the sow's nest as a protection for the young pigs, or otherwise there is danger of their being crushed against the walls as the sow lies down. This rail must be strongly bolted in place and should be spaced 8 inches from the wall. The bolts should be placed in the concrete when it is poured. There should also be 8 inches clearance space under the rail, so the young pigs can get under it.

An alternate method of construction of the pens is shown in Figure 113. In this construction the feed troughs are made a part of the floor and over them is fastened a wooden gate, which is hinged, as shown in the cut. By using this scheme the pigs can be prevented from getting at the trough while it is being cleaned.

Figure 110 shows a plan of a hog house. The superstructure of this hog house may be made of wood, and it is built with a monitor roof so that the windows in the monitor face the south. By this arrangement the pens on both sides of the building receive the maximum amount of sun.

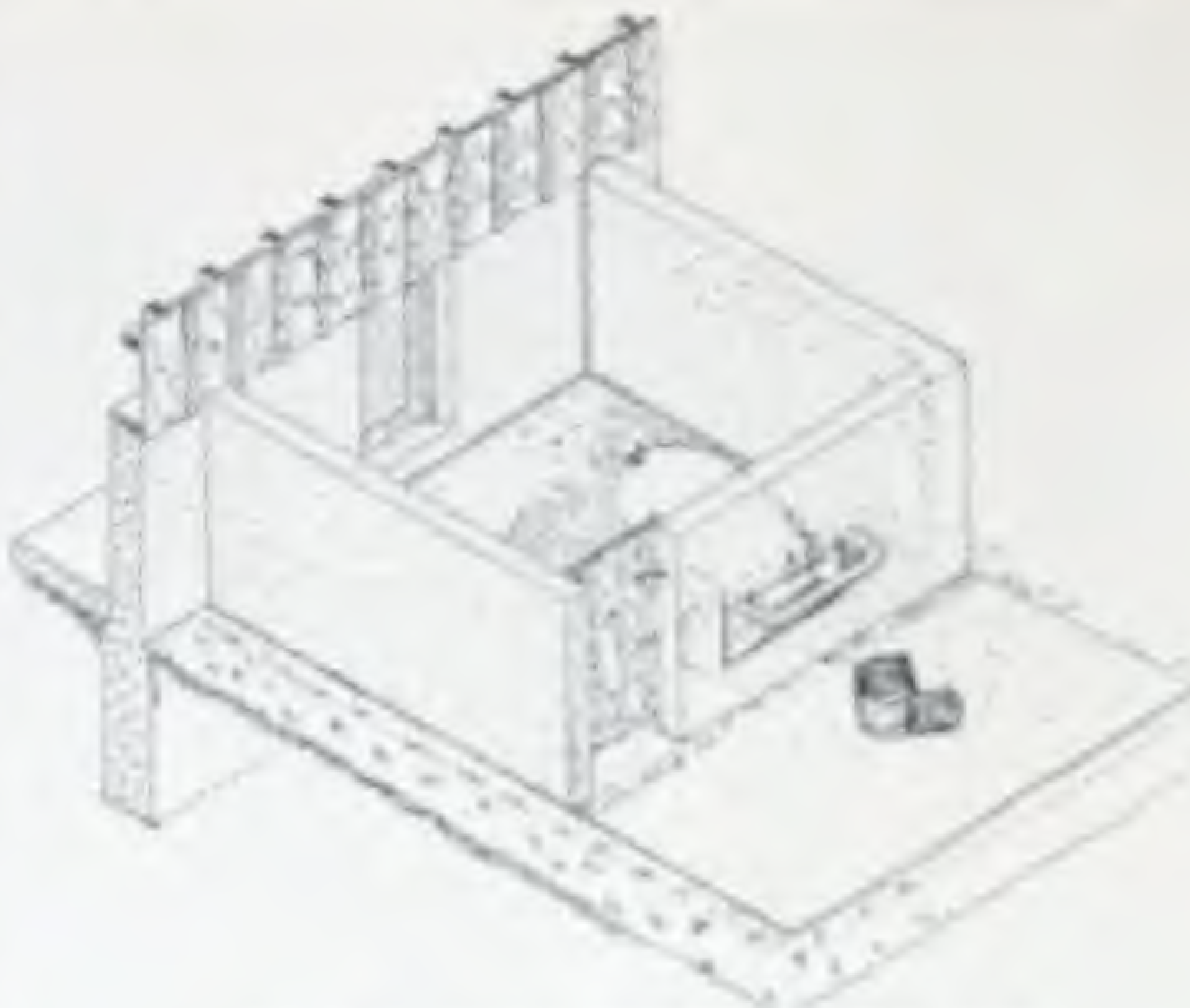


Fig. 113—Detail showing pen and trough.

The yards should be enclosed with wire fencing on concrete posts (see pages 68 and following). The posts should be set in a curbing (see page 38), which should go down at least 2½ feet to prevent the hogs from digging under, as their rooting might undermine the posts.

Fig. 112—Concrete aisle between two rows of hog houses with feeding troughs.

Fig. 114—Circular drinking trough of concrete, no corners to leak or bark legs of horses or cattle. The concrete pavement keeps the approach to the trough from getting muddy.

Concrete watering troughs

Concrete watering troughs are permanent, substantial and sanitary. They do not rot or decay, nor do they require frequent painting. They can be built easily and economically with ordinary farm labor.

The foundation must be firm and solid, as the tank full of water is very heavy. If the soil is not firm and even, excavate 18 inches and fill in with gravel or cinders well packed. Inlet and outlet supply pipes should be installed before the forms are constructed.

Forms—Figure 116A shows the method of constructing the forms. The base is built first. Notches are left in the base when the walls are built in order to give a watertight joint. These are made by laying 2-by-4-inch strips in the soft concrete and removing them before the concrete has hardened. The outside forms are supported on stakes driven into the ground. The inside forms are really hung from the outside forms as shown. The inside braces are kept a few inches above the floor so that the floor can be finished with a trowel while the forms are still in place.

Fig. 115—Square drinking trough for pasture.

The reinforcement may be woven wire fencing or ¼-inch round rods, spaced 6 inches apart each way (Fig. 120). When it is necessary to join ends of reinforcing bars, they should be overlapped at least 12 inches and tied together with wire.

The mixture must be rich so that the concrete will be waterproof. Use 1 part Atlas Cement, 2 parts sand, and 3 parts gravel or crushed stone, and be sure to have the aggregates very clean and well graded. The concrete should be of wet consistency and thoroughly worked in the forms by puddling. Pounding the forms with a block of wood on a stick will secure a smooth, dense surface. Remove the forms as soon as concrete will sustain itself, and finish with a rubbed finish as described on page 16.

It is best to lay a pavement around the trough as shown in Figures 114 and 116. This prevents mud around the trough in wet weather or in case the tank overflows.

A circular tank has marked advantages. Cattle don't scrape their legs against a round tank. It is easy to make it watertight, as it has no corners. It requires less material for a given capacity than a square trough. A good size is shown in Figure 116D. It can easily be built with circular silo forms (see under Forms, page 15, Figure 19).

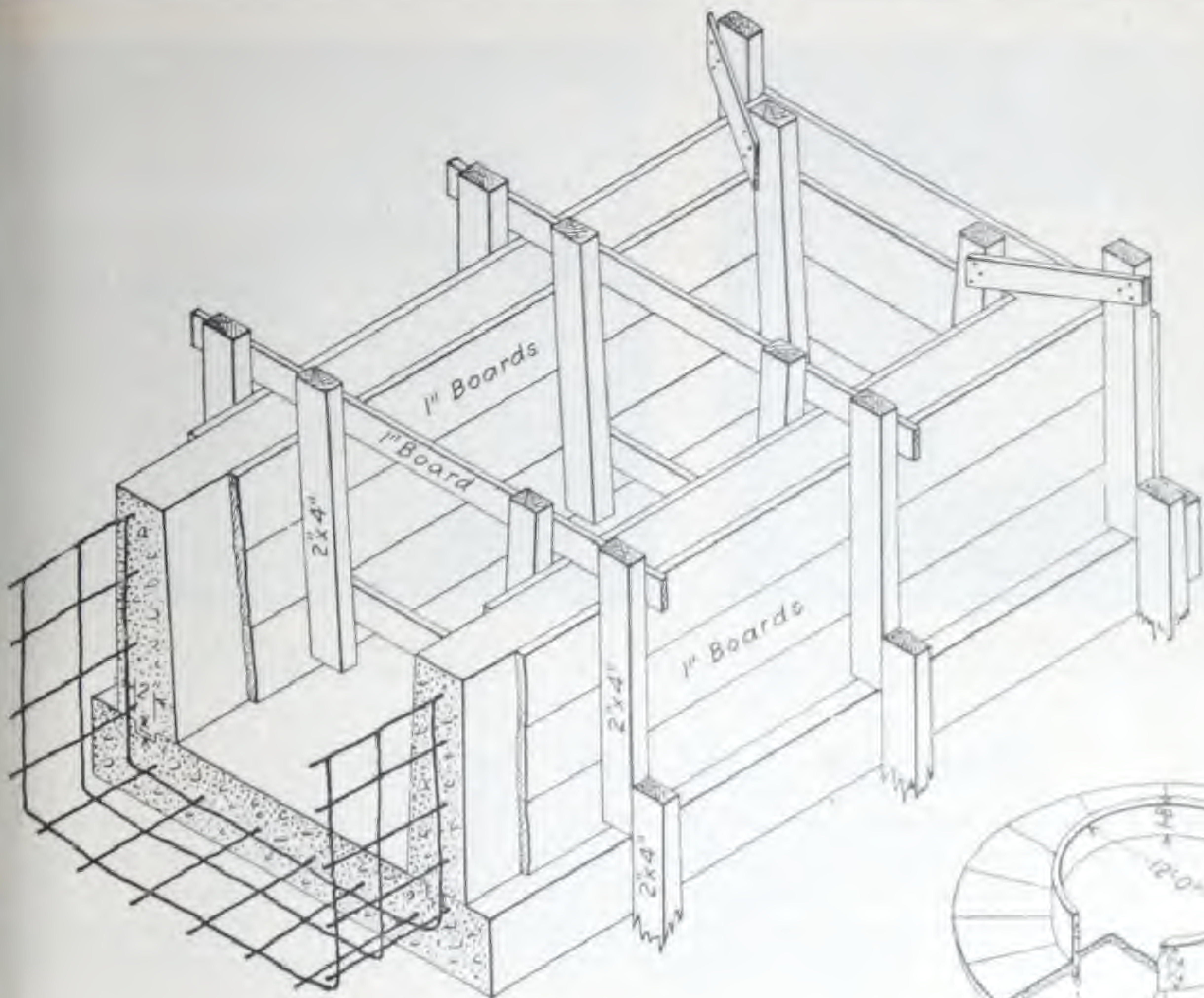


FIG. A

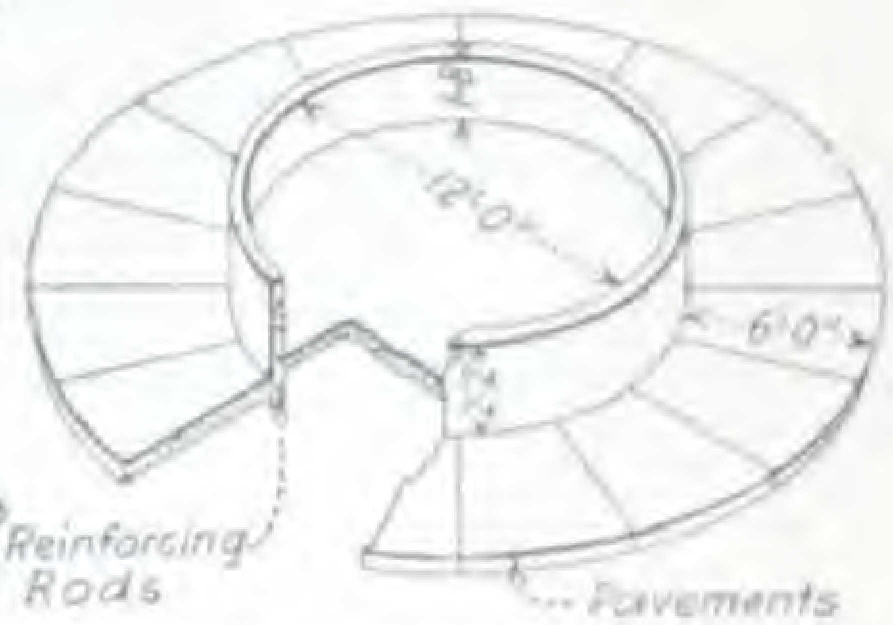


FIG. D

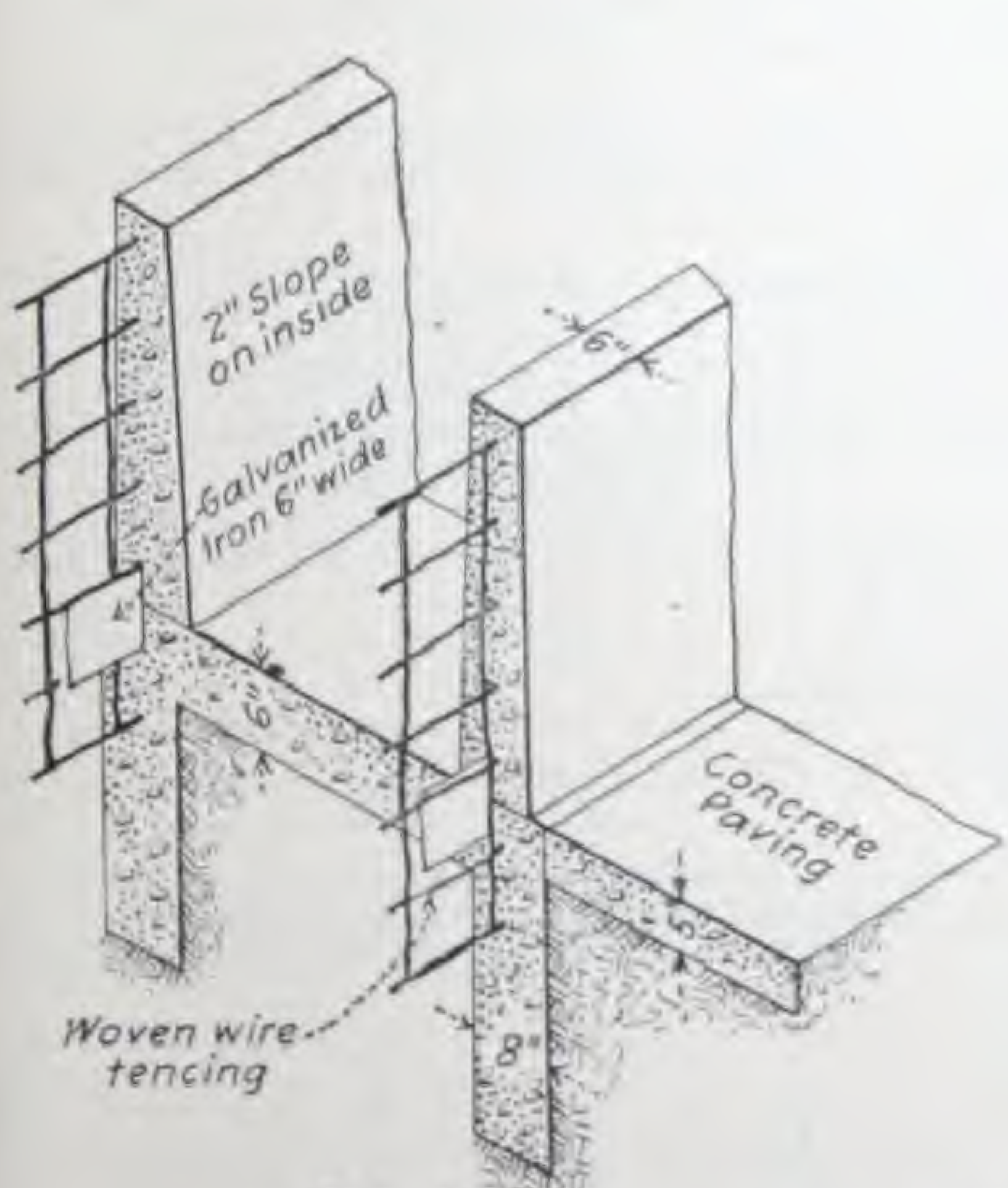


FIG. B

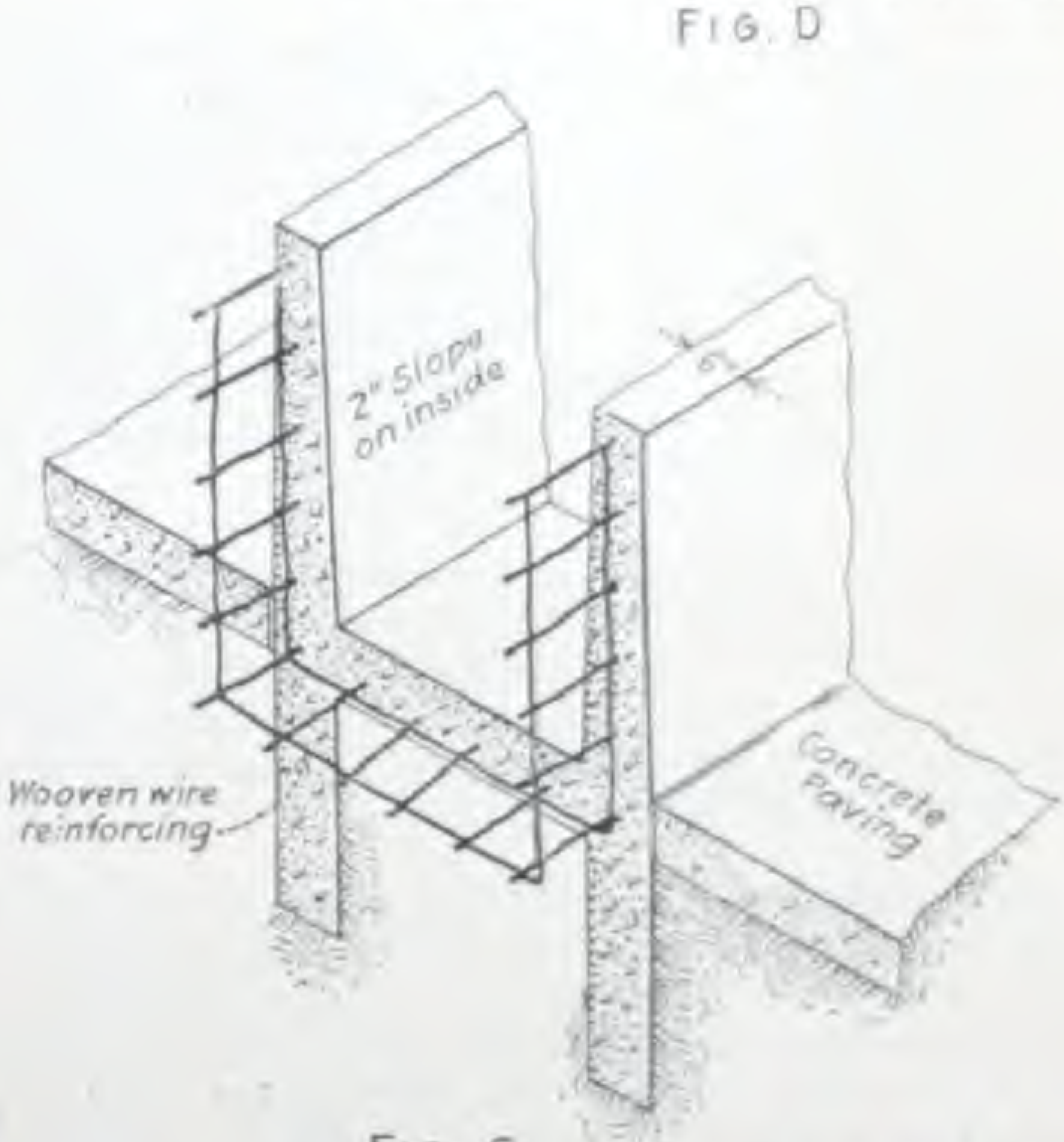


FIG. C

Fig. 116—A—forms for rectangular tank, 3 feet 2 inches by 8 feet outside, walls 2 feet 1 inch deep, floor 5 inches thick; requiring 9 bags Atlas Cement, 18 cubic feet sand, 27 cubic feet gravel.
B and C—reinforcing, inside slope, and pavement. D—forms and reinforcement for circular tank.

General information on reinforcement is on page 17.

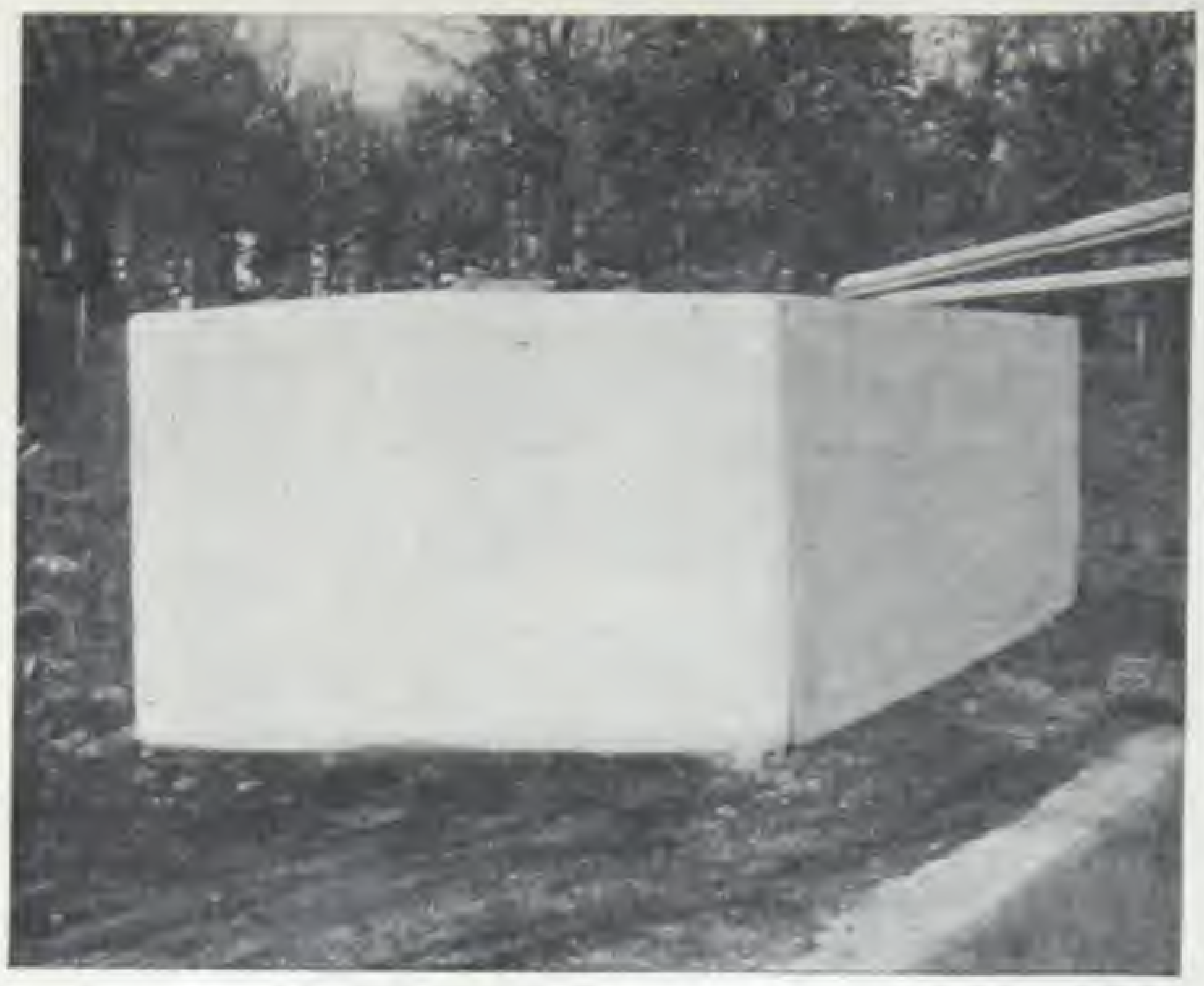


Fig. 117—Concrete cistern built on top of the ground with rain leaders from house roof. Total cost, $37.75

Fig. 118—Concrete water storage tank with wooden r built beside windmill.

Concrete tanks and cisterns

The advantages of storing water on the farm are obvious. Concrete has no equal as a material f water tanks. Wooden and iron tanks rapidly go to pieces, especially if they are alternately full and empt If they are built below ground their life is extremely short. They rust or decay and thus foul the wat they contain. Concrete tanks are permanent and they keep the water sweet and pure. They are economi and easy to build—and they cost practically nothing for upkeep, for they don't have to be painted li iron or wood.

How you can build them

Forms—Tanks may be built square or circular. The forms are built as shown in Figure 119. Build the inside forms first, resting the upright studs that come down on the inside of the tank forms on blocks the thickness of the bottom of the tank. The boards of the inside form will only come down to the top of the floor of the tank. The tops of the studs of the inside forms are nailed to the 2-by-6-inch cross planks extending to the top of the tank. The blocks supporting the inside forms may then be removed as these forms hang from the 2-by-6-inch cross planks.

Pouring—The concrete for the tank must be poured in one operation to prevent joints that might cause leakage. This is usually possible as the amount of concrete required is comparatively small. If the tank rests on a foundation, this foundation can be poured separately. The floor may be poured first (see page 30).

Mixture—The concrete should be a rich mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel, with water enough to give a mushy consistency. The concrete must be very carefully mixed so that the tank will be watertight. As it is being placed in the forms it should be thoroughly and continually worked or churned with a narrow pole or stick, so that it goes into all corners and around the reinforcing. Tapping the forms with a hammer will give the concrete a smooth, dense surface, and if this is done there will be no need of any special finishi with wooden float or steel trowel.

You can figure the materials required by reckoning sep rately the amounts needed for floors and walls as explain on pages 8 and 9.

For reinforcement see the table below.

Table of wall thickness and reinforcement required f rectangular tanks.

Depth of Tank.	Thickness of Wall.	Spacing of 3/8-inch Round Rods.		Spacing of 1/2-inch Round Rods.	
		Vertical.	Horizontal.	Vertical.	Horizontal.
Feet.	Inches.	Inches.	Inches.	Inches.	Inches
3	5	5	10	10	20
4	5	4	8	8	16
5	5½	3	6	6	12
6	6½	2½	5	5	10
7	8	..	..	3	6
8	9½	..	..	2½	5

Instructions for washing and grading sand and gravel are on page 5.

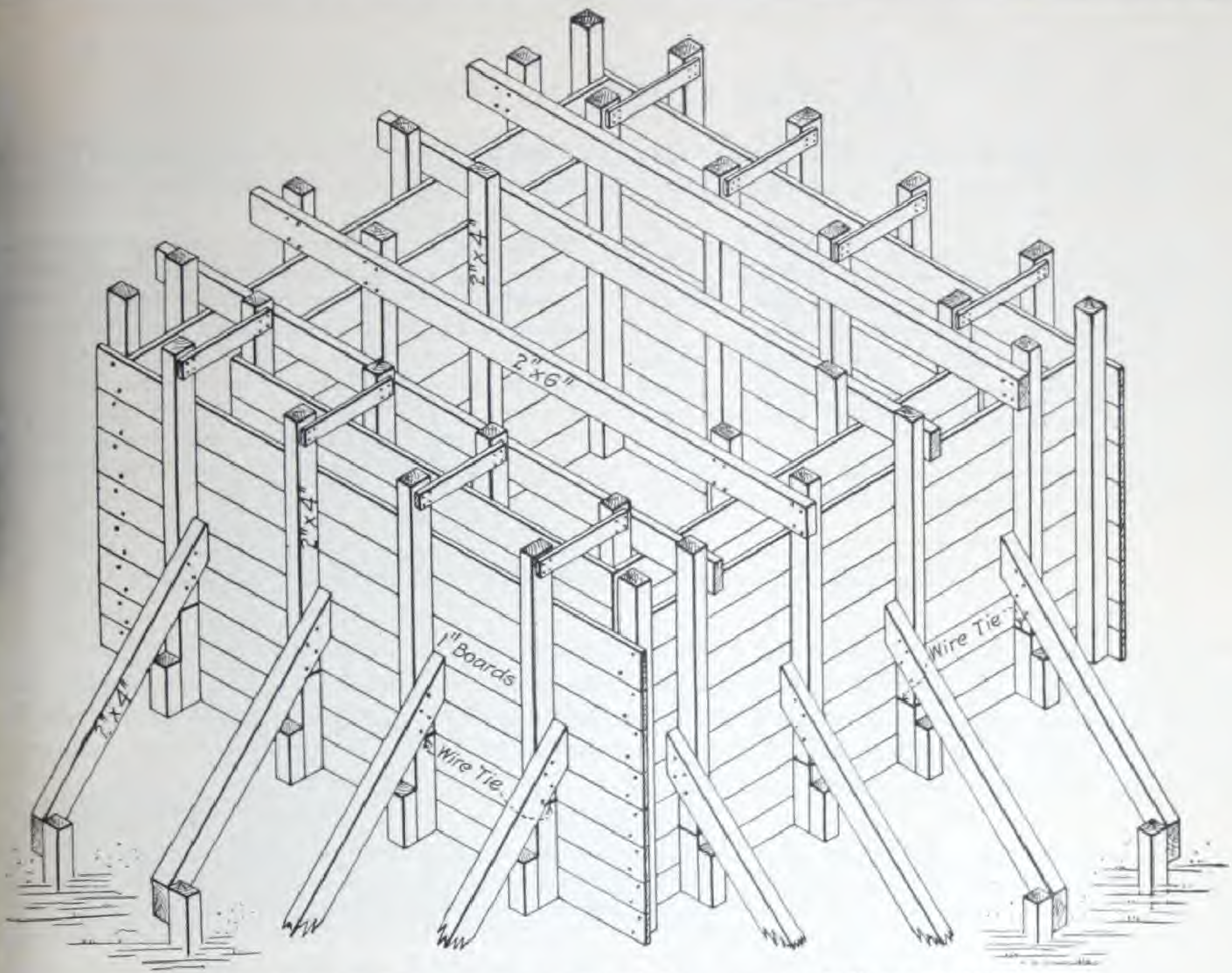
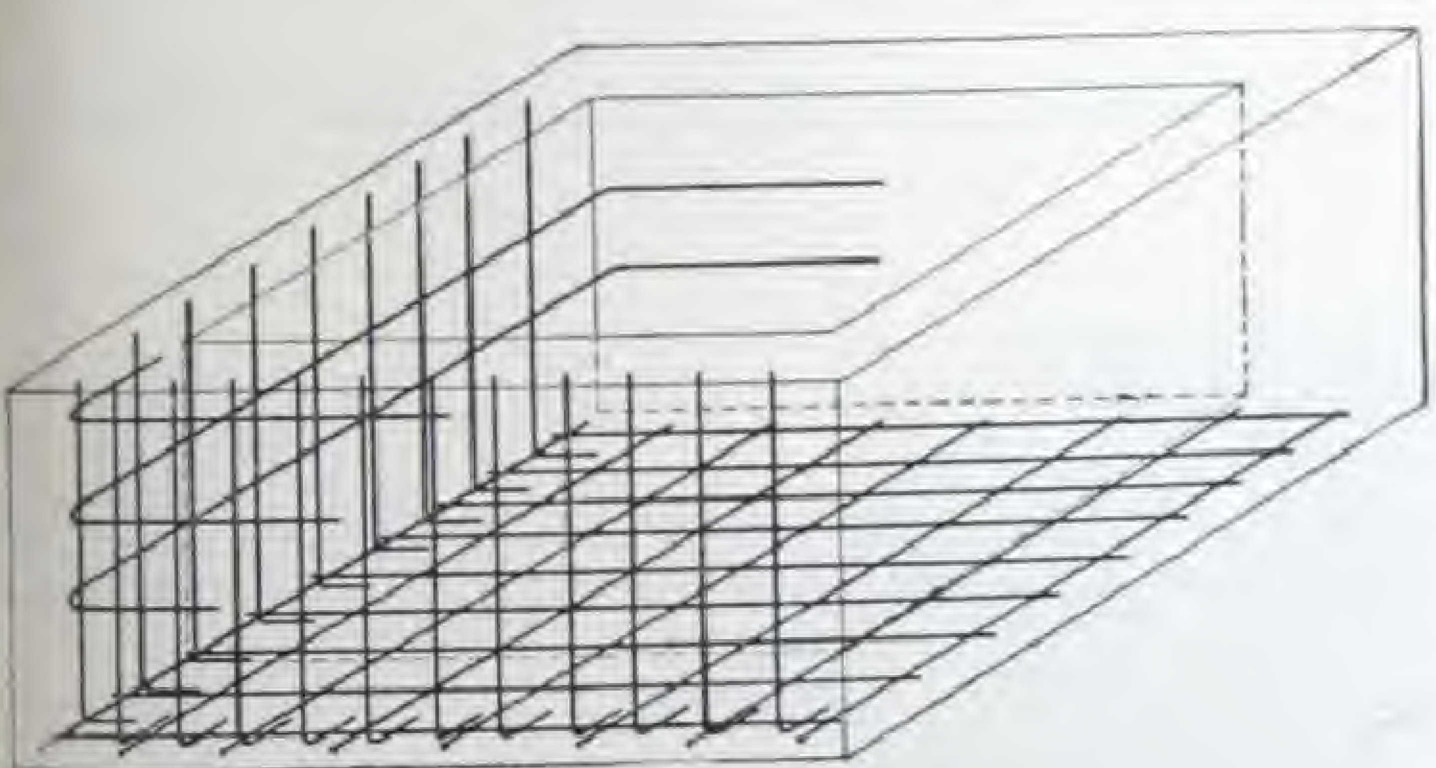


Fig. 119—Forms and bracing required for a concrete tank construction.



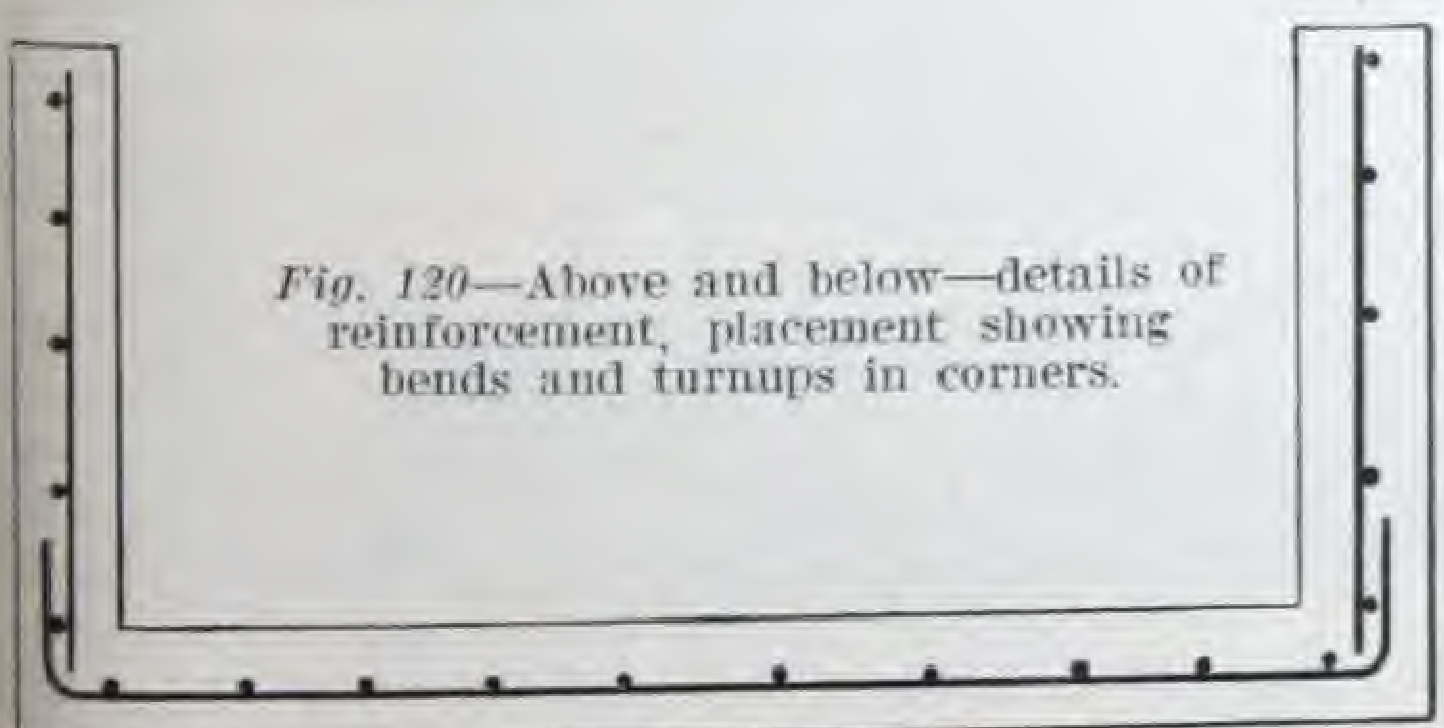


Fig. 120—Above and below—details of reinforcement, placement showing bends and turnups in corners.

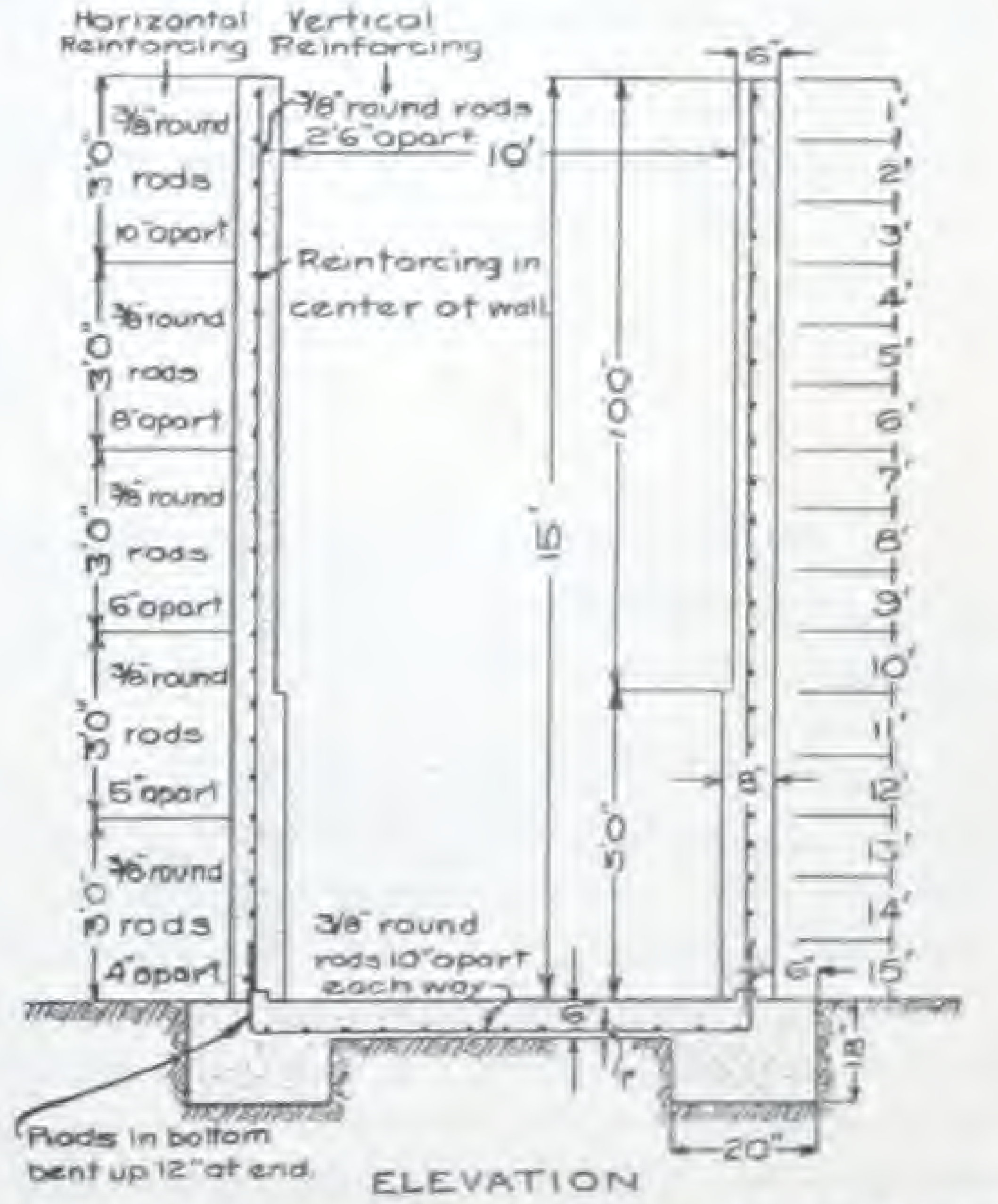


Fig. 121—Diagram showing number and size of reinforcing rods for different depths of tank, footing at foundation and the varying thickness of the side walls. For different depths use thickness and reinforcement from top down to required depths. Place bottom and footings the same for all depths.

For expert advice on your construction problems, see page 19.

Circular tanks of concrete

The main advantage of a circular tank is that less material is needed for a given capacity than fo square tank. It is not so easy to construct unless a silo form or some other circular form is available.

Reinforcing—The reinforcing rods for the bottom of a circular tank are laid at right angles to each other, in the same manner as the bottom of the square tank. The size and spacing are the same as for square tanks.

The reinforcing in the walls of circular tanks is mostly horizontal, and as the pressure against the walls is far greater at the bottom than at the top the reinforcing must be closer together near the bottom.

The vertical reinforcing is spaced the same for all sized tanks and is made up of $\frac{3}{8}$-inch bars, 36 inches apart.

The horizontal reinforcing also is made up of $\frac{3}{8}$-inch b placed equally distant from the inner and outer surfaces the wall. The varying spacing of this horizontal reinforc is shown in Figure 121, which shows the reinforcing fo tank 15 feet high. If the height of your tank is to be l than that, space the reinforcing as it is in the upper part the larger tank measured as far down as the entire depth the smaller tank. That is, if the tank is 8-feet deep, t reinforcing will be like that of the upper 8 feet of the 15-f tank.

Covers for tanks, cisterns and wells

The roof or cover for a tank, cistern or well is usually a flat reinforced slab, constructed the same as a other roof (see page 15 on roof forms), except that a 2-foot square manhole or trap-door opening shou be left so that the forms may be removed and access had to tank at any time. This is done by nailing square form or box with sloping sides 2 feet square and 6 inches high on top of the roof form at t place the manhole is to come. (See Figure 124.)

The forms for the flat roof are built inside the tank and supported by uprights from the bottom of the tank. Another form, made of boards 5 inches high, should be built around the outside where the roof is to come. The reinforcing should be placed 1 inch from the bottom of the roof form.

Reinforcing—For a slab 4 feet square or less, use $\frac{3}{8}$-inch rods spaced 6 inches apart each way and a slab thickness of 5 inches. Slabs with spaces from 4 to 6 feet should be inches thick, and the reinforcing should be $\frac{3}{8}$-inch ro spaced 5 inches in both directions.

Construct the cover of a mixture of 1 part Atlas Ceme 2 parts sand and 4 parts gravel or crushed stone. A slab feet square and 6 inches thick will require 4 bags Atl Cement, 8 cubic feet sand, and 16 cubic feet gravel or sto

Well platforms

A sanitary covering for the drinking water well is best secured by a concrete platform. It is con paratively inexpensive; it is permanent; can be made tight and strong; and will prevent the entrance surface water or refuse water into the well.

Construction—First build a concrete curb on top of the well lining and high enough to prevent surface water from flowing into the well. Around this lay a pavement at least two feet wide to keep the earth around the well from becoming muddy. This is shown in the figure. Across the opening will be placed a slab of concrete. As this is unsupported it will have to be reinforced. The amount of reinforcing and its position are described on this page, under the description of covers for concrete tanks and cisterns.

It is preferable to build this slab to one side of the well, and after it has hardened sufficiently, skid it into place over the well. This method is shown in Figure 126. Timbers are laid so that the tops of them are level with the top of the well curb. On these timbers is built a floor of boards with boards on edge for the side forms. This is the form for the sla Leave a hole in the concrete for the well pipe. When t slab is moved over the well it should be bedded in place wi cement mortar mixed in proportion of 1 part Atlas Ceme and 3 parts of sand. Only a slight amount of mortar will required.

Mixture—The concrete should be mixed in the proporti of 1 part Atlas Cement, 2 parts sand, and 4 parts broken sto or gravel. The concrete should be finished with a woo float and allowed to harden for at least 10 days before it moved over the well and the pump placed on the platfor A slab 6 feet square and 6 inches thick will require 4 bags Atlas Cement, 8 cubic feet sand, 16 cubic feet gravel crushed stone.

For the advantages of a silo, see page 51.

Fig. 122—A circular concrete water tank.

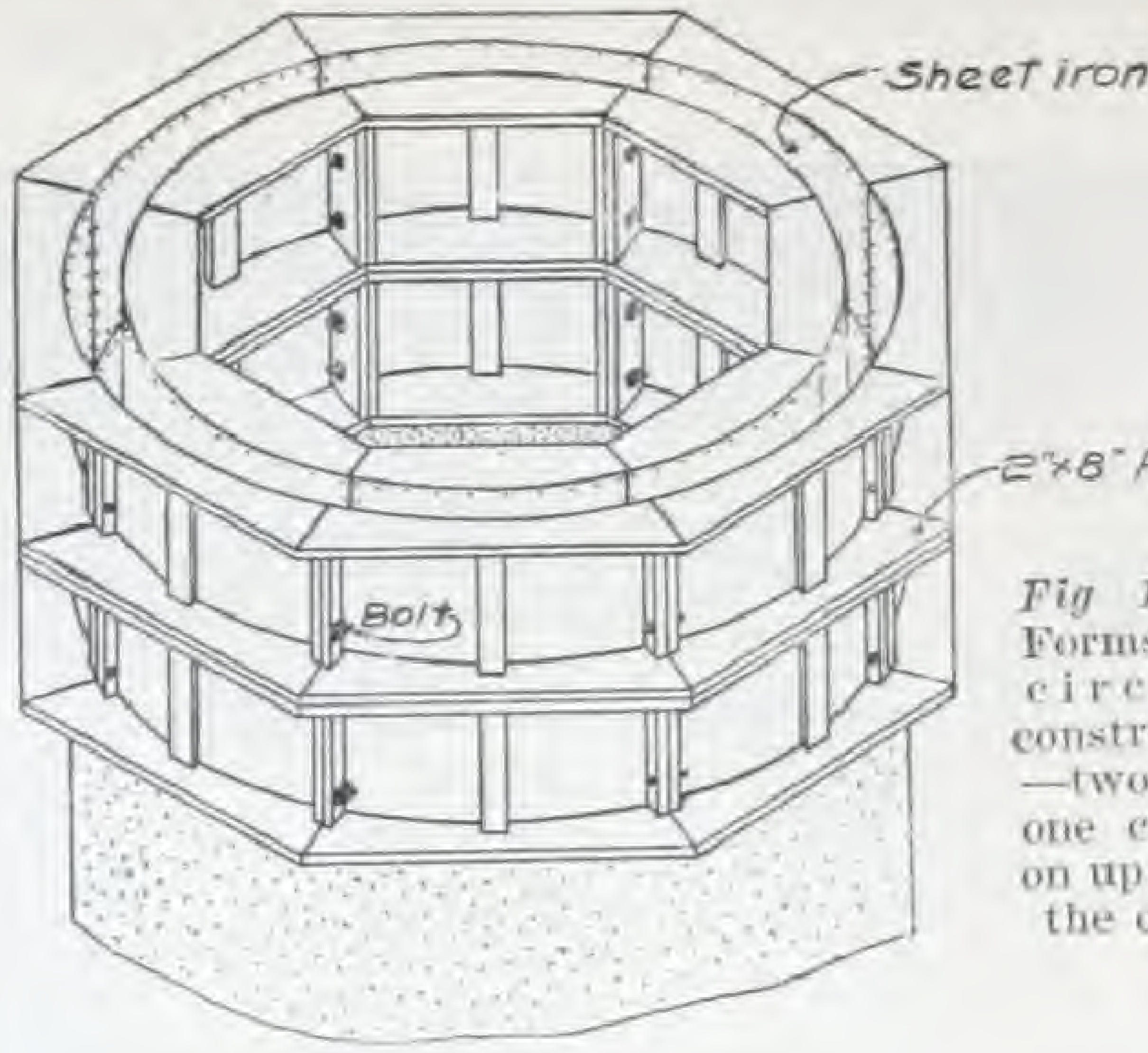


Fig 123—Forms for circular construction—two sets, one carried on up above the other.

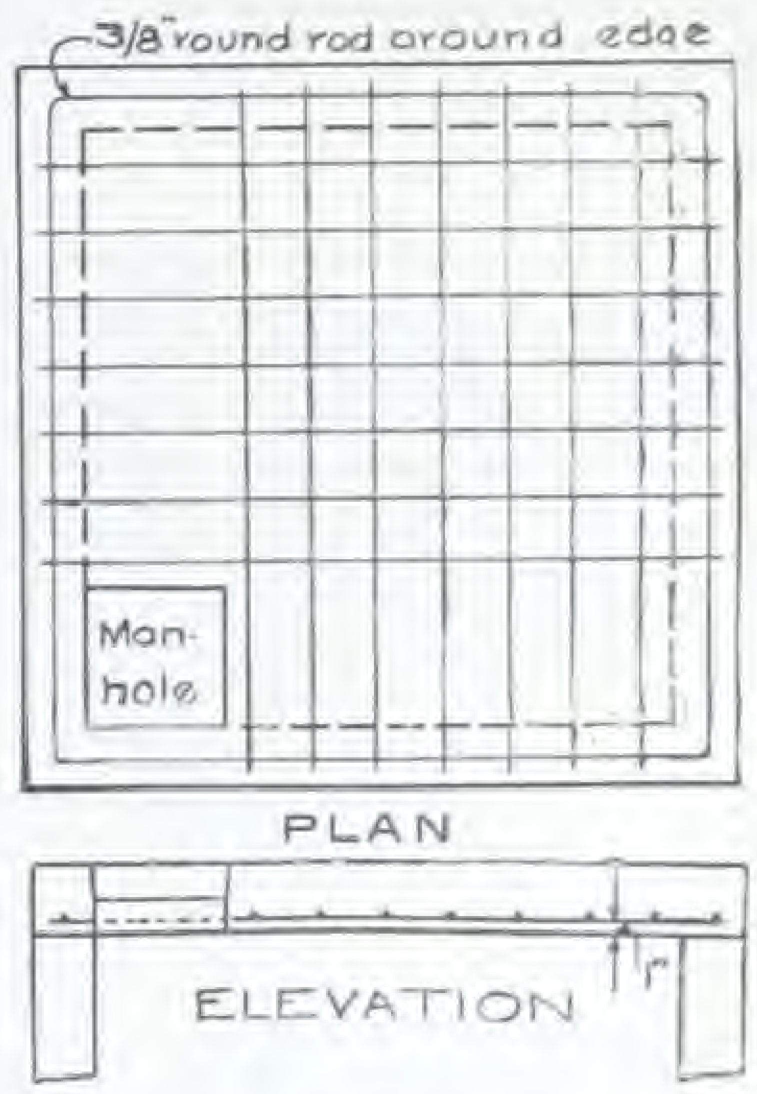


Fig. 124—To the left, reinforcement for square cistern cover.

Fig. 125—A substantial, clean, sanitary well platform of concrete.

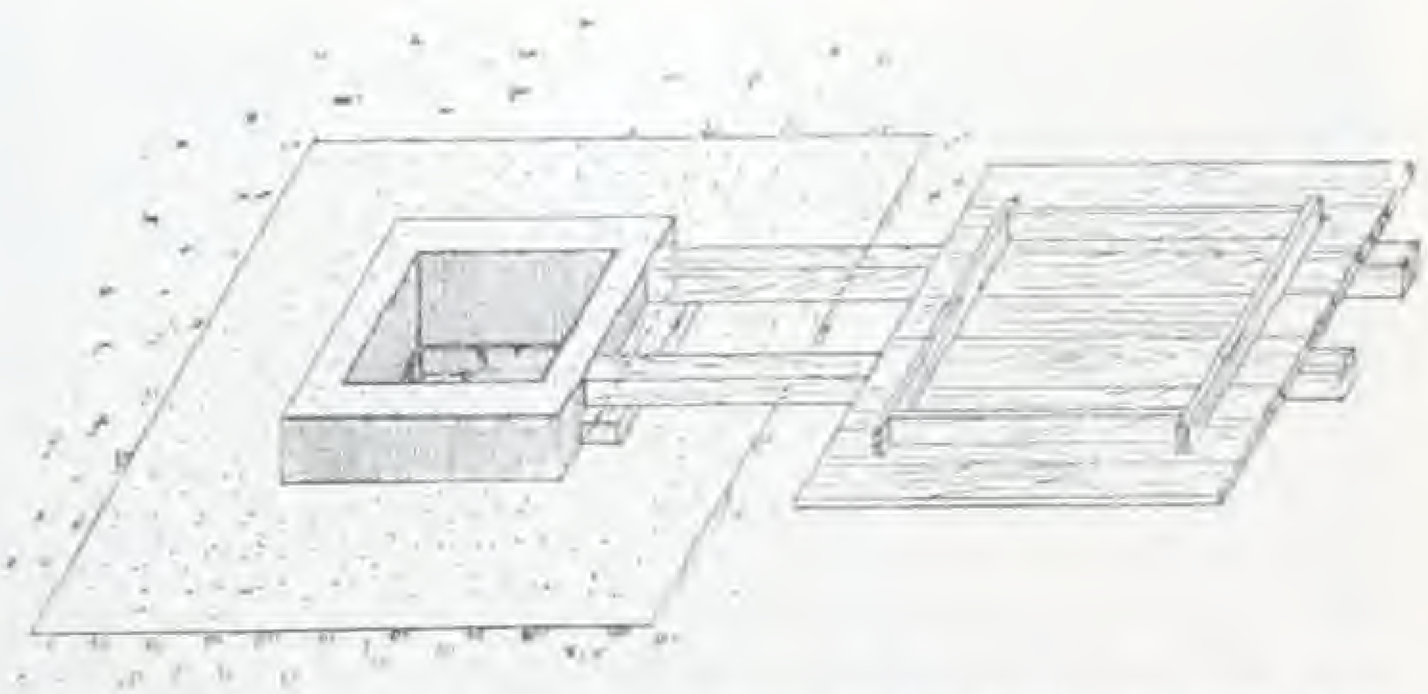


Fig. 126—Forms for well cover to be built at one side of the well and then skidded into its place over the top of the well.

Summary of directions for choosing aggregates on page 6.

Concrete manure pits

Fig. 127A—Two manure pits built at corner of barn.

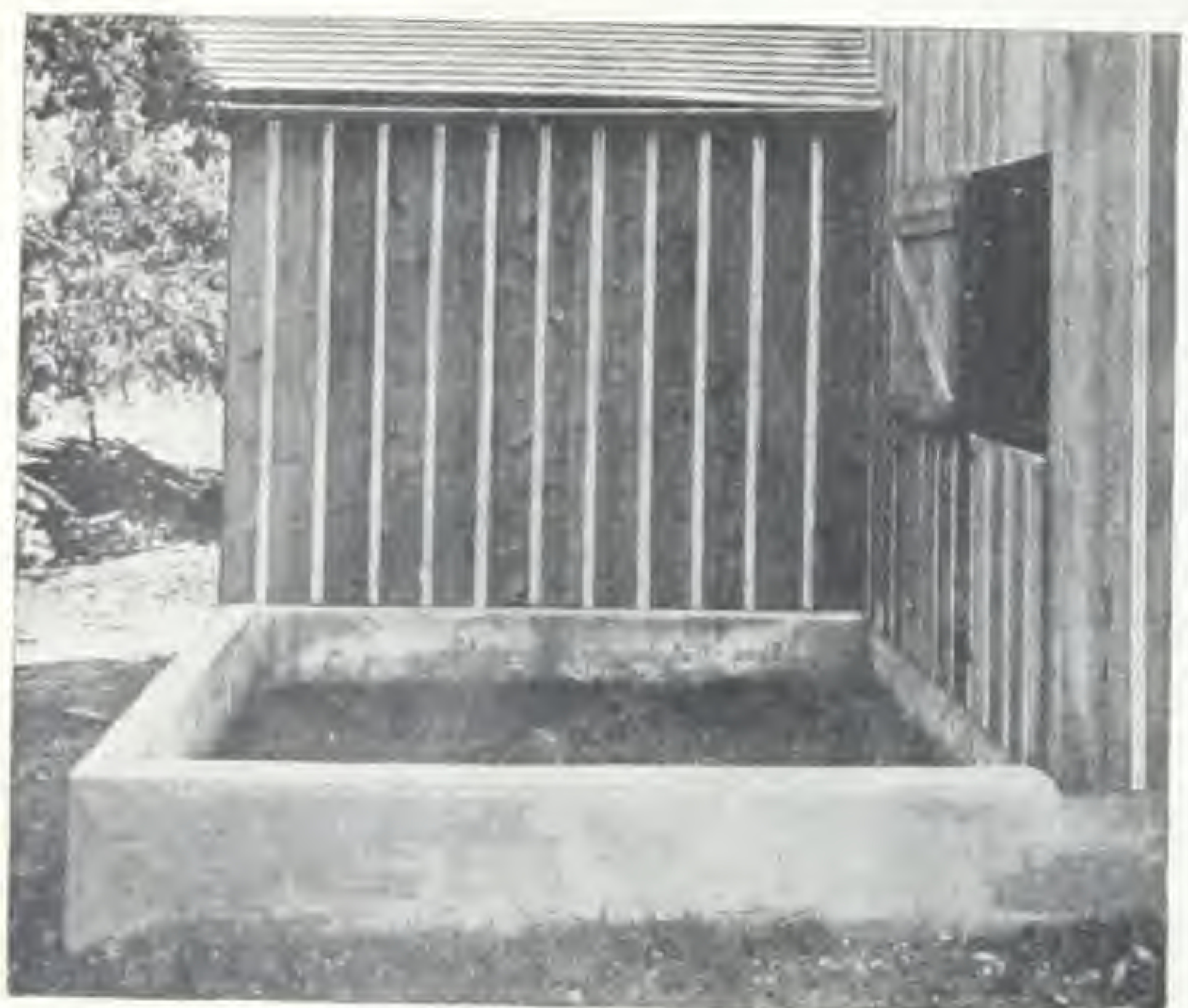


Fig. 127B—Small open manure pit against barn.

Fig. 128—Open manure pit of concrete with trolley carrier.

The most valuable parts of manure for fertilizer are the soluble parts. Manure stored in the old way under the barn or in the barnyard is exposed to the rain, which dissolves these parts and carries them into the ground where they are wasted.

A concrete manure pit preserves the full strength of the manure, and this saving more than pays for the cost of the pit.

The U. S. Bureau of Animal Industry (Department of Agriculture) says that "one load of manure from a concrete pit is worth 1½ to 2 loads of manure as usually stored."

The whole trend of the times toward more thrift and a more careful conservation of natural resources —with the greatly increased cost of artificial manure —points to the adoption of concrete manure pits.

A concrete pit may be easily roofed over (Figure 129), and this will largely eliminate the nuisance of flies whose chief breeding place is in manure piles. Complete protection from flies and the diseases they carry may be secured by screening in the posts of a pit like that shown in Figure 129, with good strong mosquito netting. This will cost something, at the start—but will be well worth the money.

Figure 130 shows a pit with inside measurements 24 feet by 19 feet, by 2 feet 8 inches deep, with floor 6 inches thick, and walls 10 inches thick at the bottom and 6 inches at the top. Across one of the ends is a gutter with opening for outlet to carry off liquid manure.

How to build

Excavate about 2½ feet deep, to allow for a 6-inch floor and yet bring the walls above ground. Slope the base of your excavation toward the end where the drain is to be so that one end is about 6 inches lower than the other and the liquid will drain to this end. Take every possible precaution to assure the storage of the valuable liquid manure.

Forms—If the ground is very firm you will need outside forms only above ground. Build the inside wall forms with a slight tilt as shown in Figure 130, to make the wall wider at the base than at the top. Use a template to shape the gutter at one end, when the concrete has been poured and is still soft and easily shaped. See Figure 64, page 35.

Mixture should be 1 part Atlas Cement, 2 parts sand and 4 parts gravel or crushed stone.

Materials Required—A concrete manure pit the size shown constructed of a 1 : 2 : 4 mixture will require 93 bags Atlas Cement, 186 cubic feet sand, 372 cubic feet gravel or crushed stone.

For drainage under floors and pavements, see page 28.

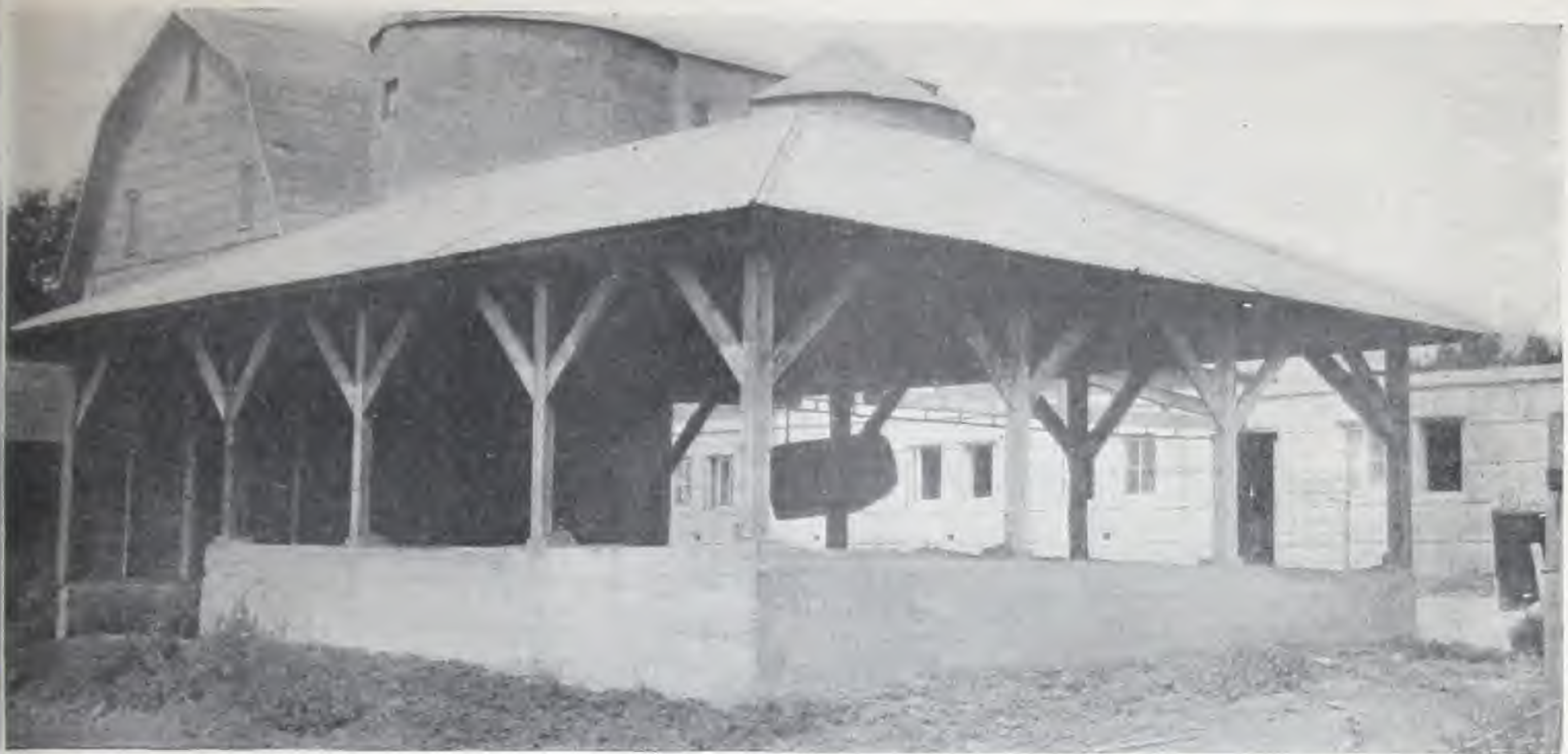


Fig. 129—Large concrete manure pit, roofed over, and provided with trolley carrier from barn.

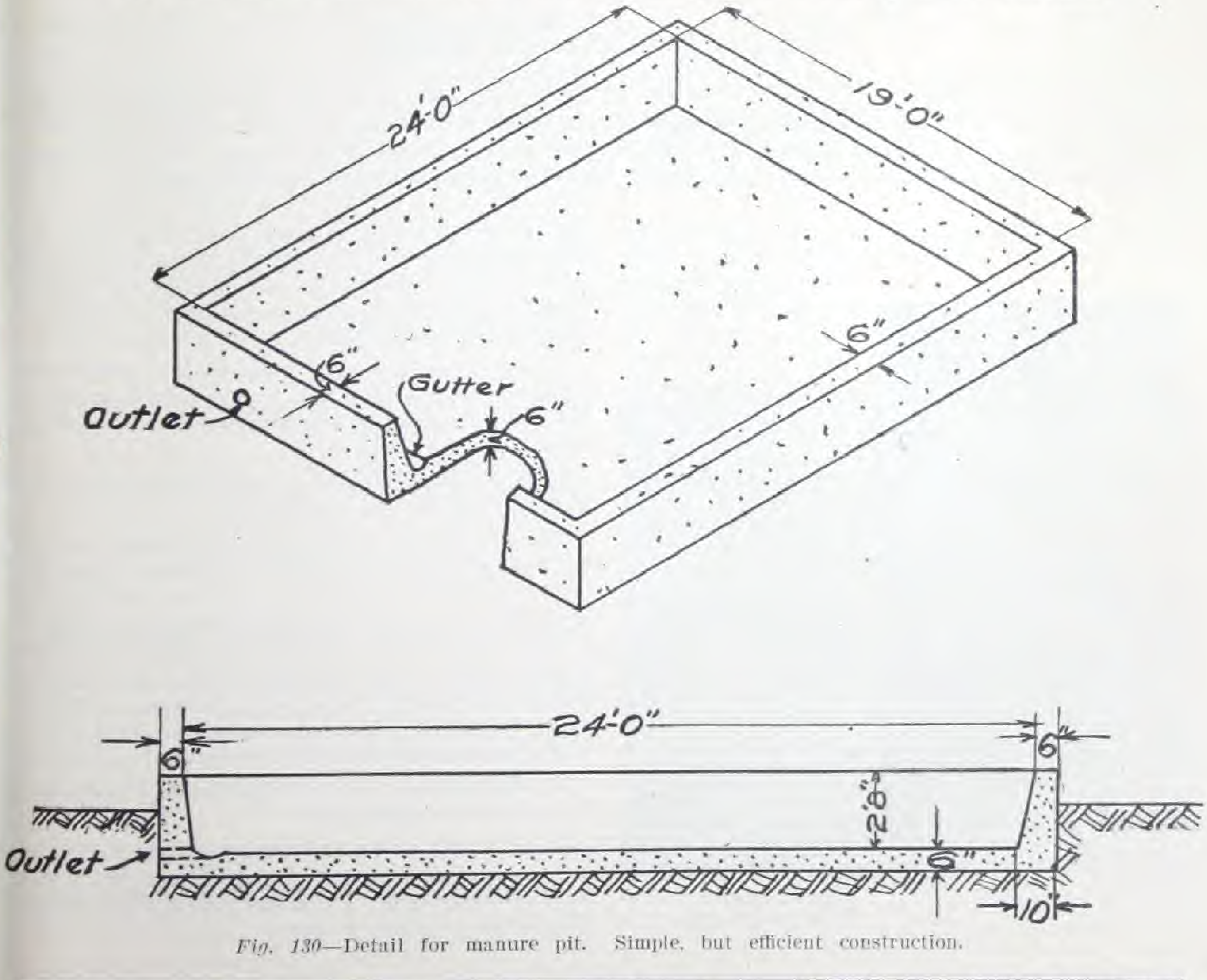


Fig. 130—Detail for manure pit. Simple, but efficient construction.

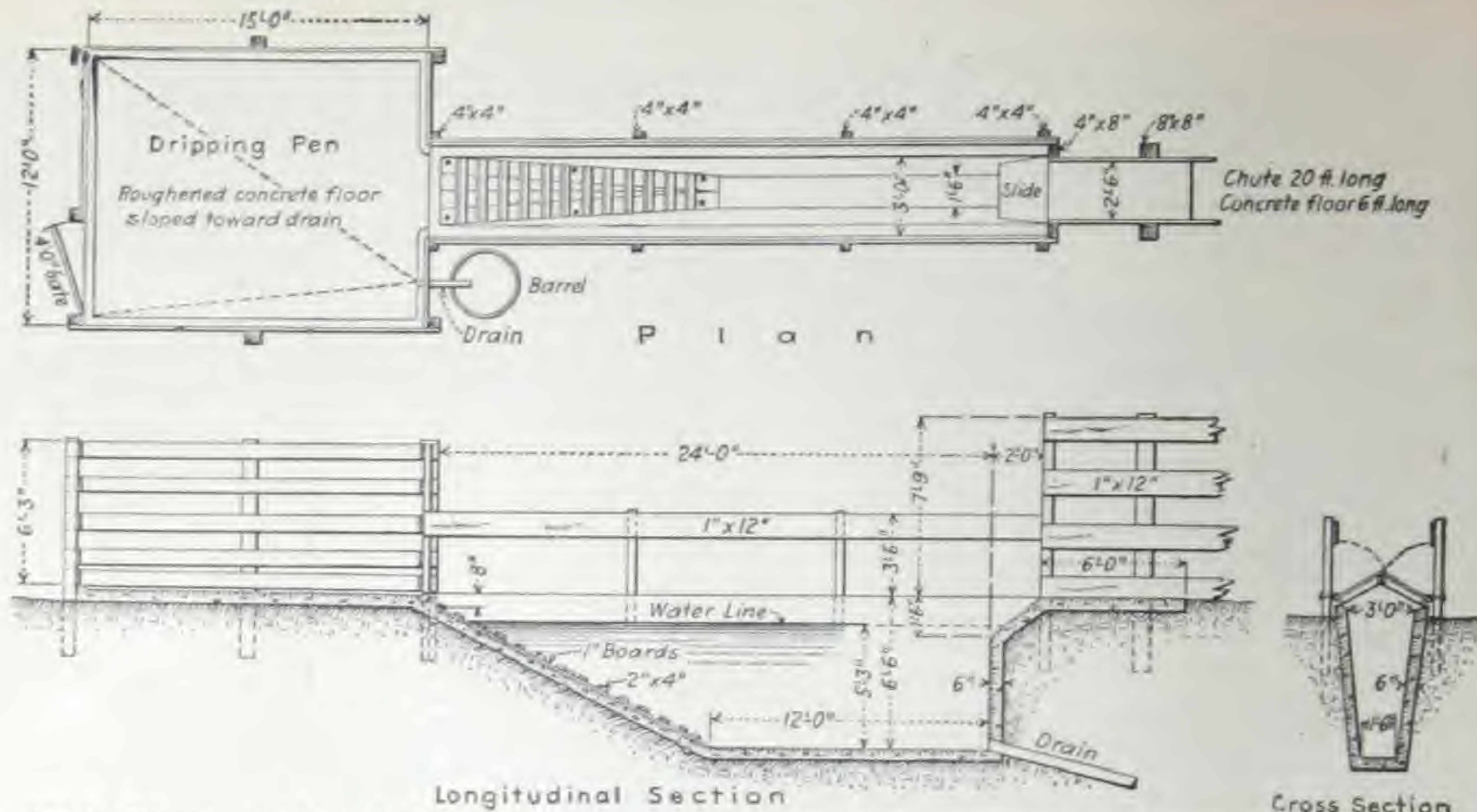


Fig. 131 A—Dipping tank and dripping pen. In right hand lower corner flap covers for dipping solution.

Dipping vats and tanks

To be in good health, cattle must be free from lice, ticks, fleas, etc. These parasites irritate the cattle, keep them from fattening, and in some instances carry dangerous diseases to them. Dipping the cattle in a vat filled with a chemical solution that will kill these pests is absolutely necessary. Concrete is the best material for such a vat, because it is permanent, tight and not affected by powerful chemicals.

Construction—The tank should be so constructed that the cattle, on entering, will slide off into the solution. As the eggs of the parasites take from a week to ten days to develop, the cattle should be dipped a second time after two weeks. The dipping serves to kill only the parasites on the cattle at the time they are dipped.

Fig. 131 B—The dipping vat in actual use. One steer is shown going up the incline into the dripping pen.

The dipping tank is made of concrete, with a chute at one end to guide the cattle into the tank and a dripping pen at the other end which has a concrete floor sloped so that the solution which drips off the cattle will run back into the tank (or into a barrel) and be saved. The tank is 26 feet long, 18 inches wide at the bottom and 3 feet wide at the top, and 6 feet, 6 inches deep, so that the solution may be 5 feet, 6 inches deep. One end of the tank has a short slope that plunges the cattle under the solution, and the other end has a gentle slope with a corrugated or cleated floor so that the cattle can easily climb out. Complete dimensions are given in Figure 131A.

Excavate 1 foot longer and 1 foot wider than the inside measurements given. Make the bottom of the excavation 6 inches deeper. Give the sides and ends of the excavation the slope shown in the plan.

Build the *forms for the walls* as explained on page 13 and allow for walls and floor 6 inches thick.

The floor of the exit incline should be roughened by cross-marking it with a bar or rod while it is still soft, to give the cattle a foothold while getting out. You can make a stout plank runway to put on the slope after the concrete is set, with wooden cleats across it to give the cattle still better footing.

As the solution will be used several times, it is best to build a cover to prevent rain from diluting the solution. This is made as shown in Figure 131A, lower right hand corner. While the tank is in use the cover is fastened back to the fence.

The mixture should be 1 part Atlas Cement, 2 parts sand, 4 parts gravel or crushed stone.

Quantities required—The tank shown will require 60 bags of Atlas Cement, 120 cubic feet of sand, and 240 cubic feet of gravel or crushed stone. This includes the pavement for the dripping pen and entrance chute.

Hog wallows of concrete

The modern farmer is getting wise about pork. He is learning the necessity of taking good care of his hogs—keeping them clean and well—and realizing on it in ready money when it comes time to kill. The idea that anything is good enough for a hog and that he loves filth and that he needs dirt—all that is being exploded. See pages 53-55 on hog houses.

If you don't give a hog a place to cool off in clean water in the summertime, he will try to build one himself of mud. The hog wallow is best built of concrete, because then it will be permanent and sanitary. If you possibly can, build it in connection with the hog house or feeding floor. See pages 53 and 36.

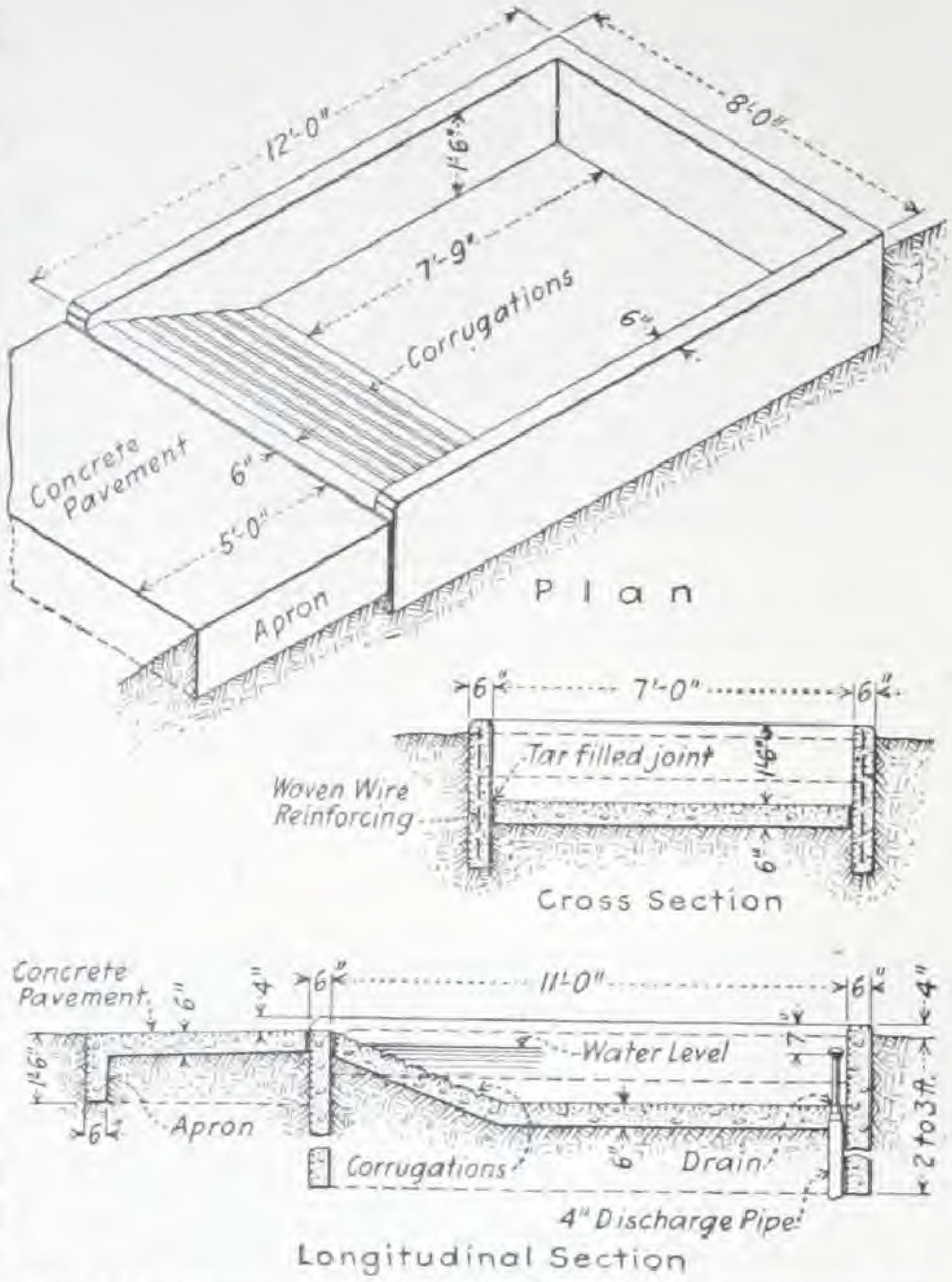


Fig. 132—Details of hog wallow showing dimensions, corrugated incline, concrete pavement and apron.

How to build

Construction—The hog wallow, shown in Figure 132, is 8 feet wide by 12 feet long outside, and 18 inches deep. Give one end a slope with a corrugated surface so that the hogs can climb out easily; or you can fasten a couple of planks together, lay them up the slope and put cleats across them a few inches apart to give the hogs a foothold. A pavement is laid in front of the incline, so the hogs will not form a mudhole when they come out. The plan provides for a drain and 4-inch discharge pipe, so that the wallow can be drained and cleaned out. A wooden gate across the outlet, as in the bottom part of Figure 132 will keep the water in.

Provide a solid foundation by filling and packing if the soil is not naturally firm and soft. Read page 28 on excavation, drainage and fill for pavements.

Build the forms for the walls as shown on page 13. Build the walls and floors 6 inches thick as shown.

The concrete pavement and apron shown in Figure 130 will be a little extra bother to build—but they will be well worth it. They will keep the ground around the wallow from being muddy and miry—which is bad for the hogs; and they prevent the hogs from rooting under the walls—which is disastrous to the walls.

Mix the concrete in the proportions of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

Reinforce the walls and floor with woven wire fencing, which should be placed in the very center of the walls and laid on top of 3 inches of concrete in the floor—with another 3-inch layer on top. Be careful to select the aggregates carefully and spade the concrete carefully in the forms to get it watertight. See page 17.

Quantities—The tank shown in Figure 132, with walls 3 feet deep, will require 27 bags of Atlas Cement, 54 cubic feet of sand, and 108 cubic feet of gravel or crushed stone.

Fig. 133—Hog wallow, with corrugated cross-corner inclines, instead of the cross-end style shown in the details above.

How to build hog troughs—see page 72.

Duck ponds

A duck pond is desirable on almost every farm, not merely because it permits raising ducks where there is no stream, but where there is a stream the pond keeps the ducks "at home."

The same kind of a pond can be built for ornament, or where there are children, for a wading pool.

A concrete pond is easily built, economical and permanent. General directions for walls and floors will tell you how to build a pond of the sort illustrated.

The dimensions of a pond are shown in Figure 134. Use a 1:2:4 mixture with aggregates carefully graded, and tamp and spade the concrete well. This tank with walls 2 feet deep will require 20 bags of Atlas Cement, 40 cubic feet of sand and 80 cubic feet of gravel or crushed stone. Two men could easily build it in 2 days.

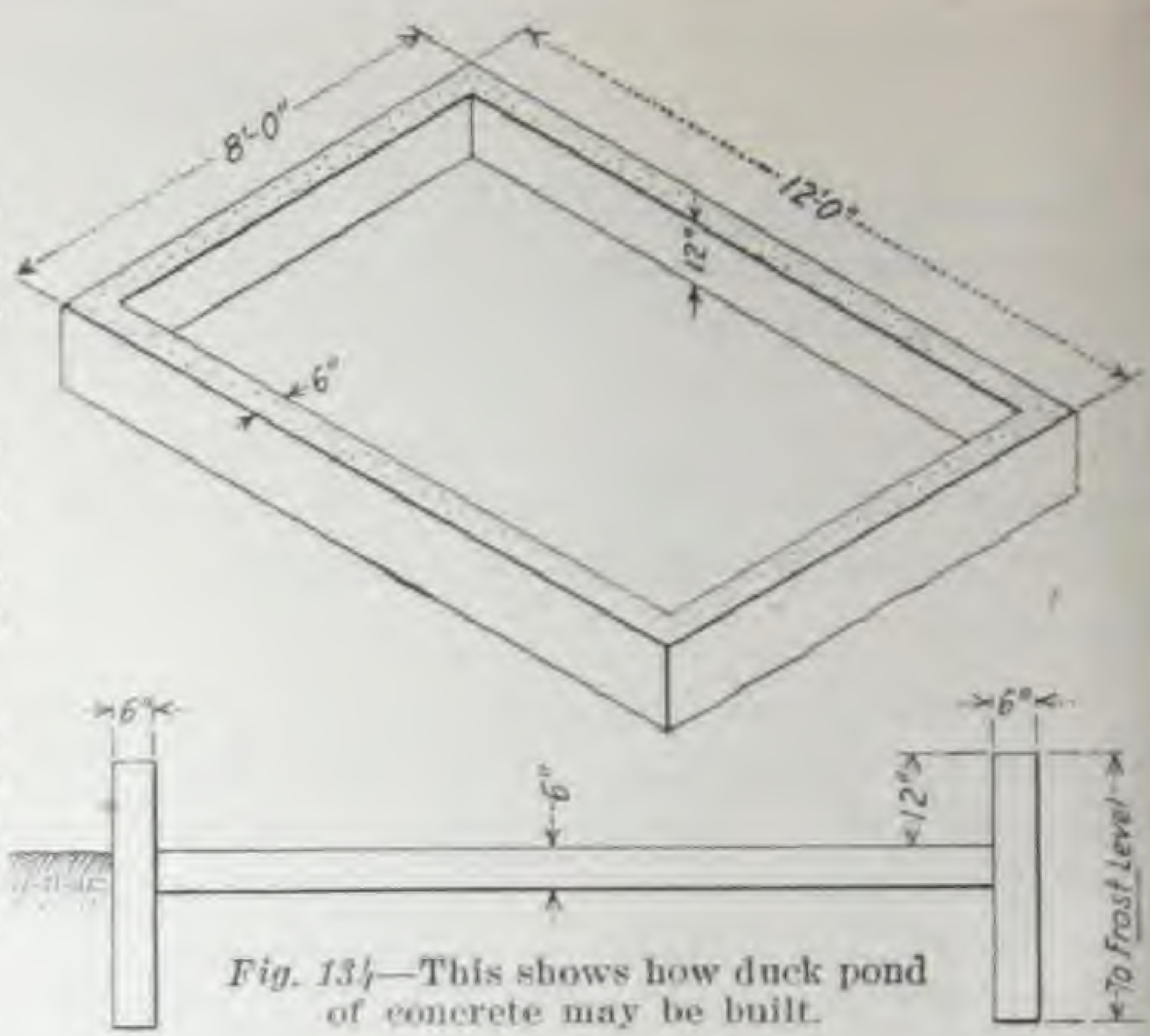


Fig. 134—This shows how duck pond of concrete may be built.

Concrete dams

In building dams there are many things to be taken into consideration such as condition of foundation, amount of flow, ice pressure, etc. A dam must resist leakage, overturning and sliding. Concrete is the best material for a dam—it is permanent, can easily be made water-tight, and is simple in construction.

For dams more than 2 feet high, you had better have a special design, based upon full knowledge of conditions, made by an engineer who should also supervise its construction.

Construction of small dams—Where it is possible, construct a temporary trench to carry the water round the dam while you are building it. If this cannot be done, run the water through a wooden trough in the middle of the dam by means of a temporary diversion dam constructed above the temporary dam site. After you have constructed the dam on each side of the sluice, you can carry the forms across the opening and complete the construction in this section. Be sure that your forms are heavy and tight.

After diverting the stream through the sluiceway, excavate for the foundation of the dam, slightly wider than the width of the dam to be built, carrying it about 3 feet below the bed of the brook; or, if the ground is soft, deep enough to reach good hard bottom.

In the construction of concrete dams you should use a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone. Place the concrete continuously if possible. If it is impossible to do this, precautions must be taken to get a proper bond between different batches of concrete deposited. (See page 17.)

The forms and bracing on the down-stream side of the dam should be left in place for two or three weeks, while the forms on the up-stream side may be removed in three or four days under favorable conditions.

Swimming pools

A concrete swimming pool is a great source of pleasure and comfort during the hot summer months. It should be located where it can be drained easily and the intake supply should be carefully planned—for a tank large enough to be adequate for swimming requires quite a quantity of water. The tank should not be less than 12 by 25 feet and 3 feet deep at one end to 5 or 6 or more at the other end.

The forms required are similar to the foundation forms described on page 13. The mixture for the concrete should be 1 part Atlas Cement, 2 parts of sand, and 4 parts of gravel or crushed stone. Care should be used depositing the cement. Thoroughly puddle it in the forms so a dense and waterproof wall will be obtained. See page 17 on waterproofing.

The inside of the pool had better be finished with a coat of cement mortar made with Atlas-White Portland Cement.

Fuller information on swimming pools is given in a booklet on the subject which is yours upon request.

Fig. 136—A practical and beautiful pond for the poultry yard.

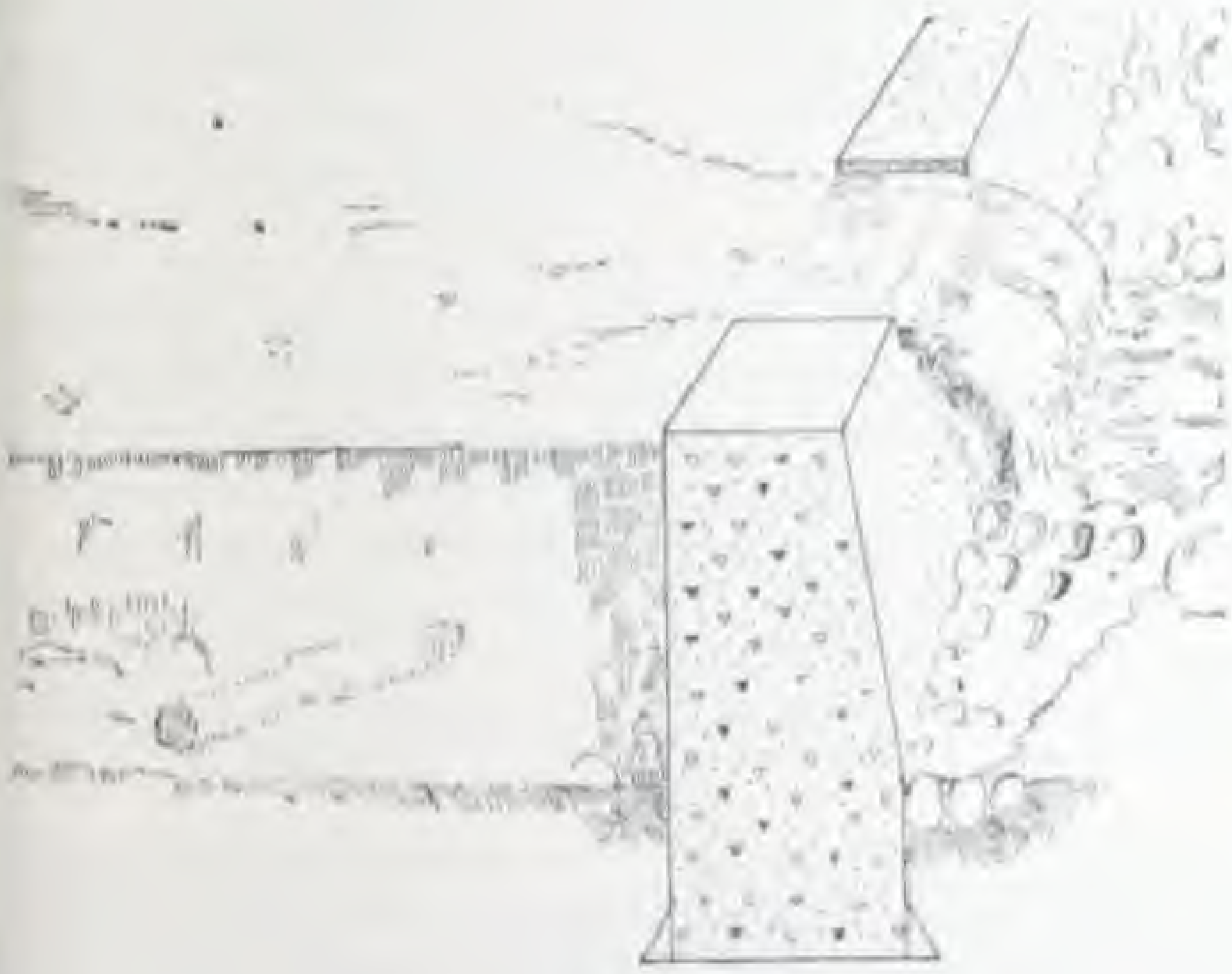


Fig. 137—Detail of small concrete dam.

Fig. 138—Solid concrete spillway and flume with concrete retaining wall.

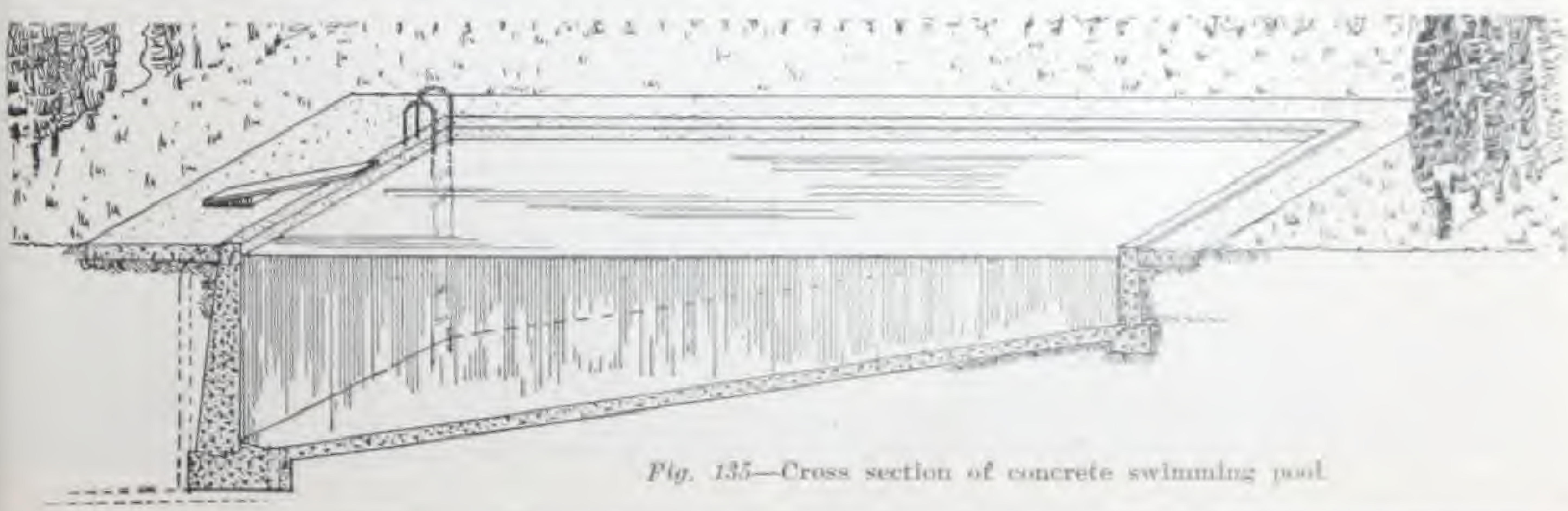


Fig. 135—Cross section of concrete swimming pool.

How to place concrete is told on page 11.

Concrete for fence posts

Concrete fence posts are coming more and more into general use. This is due not only to the scarcity and high price of good straight wood posts, but to the permanency of the concrete post, its greater strength and more pleasing appearance. When a wooden post rots, it allows the wire of the fence to fall to the ground where it quickly rusts and is lost. The concrete post always keeps the wire in proper position and ensures a permanent and safe enclosure for the field. Weeds always grow along fences, where it is extremely difficult to mow them either by machine or by hand. If you have concrete fence posts it is easy and entirely practicable to burn the land over. Fire will not harm concrete posts although it destroys wooden ones.

How to build posts

Size and shape—The length of the post is determined by the height which is desired above ground.

Concrete fence posts should be a little larger than wood fence posts, and may be either straight or slightly tapering. An ordinary size is 5 or 6 inches square at the bottom and 4 or 5 inches square at the top.

Forms—Posts may be built separately—that is, each in a separate form laid on the ground—but it is much cheaper to build forms for a number of posts so that several can be molded at the same time, and then the forms can be used for another set as soon as the concrete has hardened.

Figure 139 shows a combination form that can be easily taken apart to take out the posts and to clean the forms. This form is for posts 4 inches square at both ends and 6 feet long. Choose a place where the posts can be left undisturbed for at least ten days. Lay 4-by-4-inch sills 4 feet long 2 feet apart, as in Figure 139, and nail a floor of 1-by-6-inch dressed lumber on the sills, making the floor 8 feet long and 4 feet wide. Make a frame of dressed 2-by-4-inch boards with the end pieces fitting into notches in the side pieces. The partitions of 1-by-4-inch dressed boards fit into notches in the end pieces. Nail triangular stop blocks at the corners and keep the frame in position while the posts are being made by driving wedges against the stop blocks. To fill the form once, that is to make 4 posts of the size given (using a mixture of 1 part Atlas Cement, 2 parts sand, 3 parts gravel or crushed stone not larger than ⅝-inch) will require ½ bag Atlas Cement, 1 cubic foot sand, 1½ cubic feet stone or gravel.

Figure 141 shows a combination form for the posts each 7 feet long and tapered from a base 6 inches square to a top 4 inches square. In this form a level surface is made as before, by nailing dressed lumber on sills to form a smooth, tight surface. To make the posts tapering, it will be necessary to make the partitions wedge-shaped and to place wedge-shaped pieces in the bottom of each mold. The dimensions of these pieces are shown in Figure 141. After the pieces are assembled between the two end-boards, they are tightened by the two wedges. The tops of the posts will then be on the same level so that they can be easily finished with a trowel. For 10 posts of this size, allow 2½ bags Atlas Cement, 4 cubic feet sand, and 8 cubic feet gravel or stone.

If posts are wanted with a taper on only two faces, use the forms shown in Figure 139 *without* the bottom pieces.

It is often desirable to bevel or chamfer the edges of the posts, because sharp corners are easily broken off. To prevent this, nail triangular shaped strips along the corners of the form as shown in Figure 140. The forms must be thoroughly greased with soap, linseed oil or crude oil before they are used.

If large quantities of posts are to be made, it is usually cheaper to use steel molds. These can be bought through building material dealers. Probably your local dealer sells them. If not, write us for names and addresses.

Reinforcing is necessary in all concrete fence posts. The size of the reinforcing will depend upon the size and length of the post. See table on page 70. The reinforcing bars must be in the corners as shown in Figure 142. Use round rods and not wire, as one wire in a corner is not strong enough and if several are used it is impossible to keep them in place. The reinforcing can best be kept in place by the simple spacers made of wire shown in Figure 142. First place 1 inch of concrete and then place two rods on top of the concrete. Then fill within 1 inch of the top and place the other two rods.

Proportioning, placing, etc.—The concrete for fence posts should be made in the proportions of 1 part Atlas Cement, 2 parts sand, and 3 parts gravel or crushed stone. Use stone that is not more than ⅝-inch in diameter so that it will go around the reinforcing properly. Tap the forms with a hammer to distribute the concrete around the reinforcement and give a smooth surface. The exposed face of the concrete may be finished with a steel trowel, but if the concrete is properly placed it will not be necessary to give the posts any additional finish.

Like all small masses of concrete, fence posts must be carefully protected until they are hard. Don't move them until they are at least ten days old or they will crack. Keep them moist by sprinkling for at least ten days, and then store them out of the sun until they are at least a month old.

Fastening wire—There are several methods of fastening woven wire fencing to the post. You can put eyelets or staples in the concrete while it is soft or leave a hole through the post, but this is likely to weaken the post. The best method is to wrap a wire around the three sides of the post that are not touched by the fencing wire, and twist it around the fencing wire as shown in Figure 142.

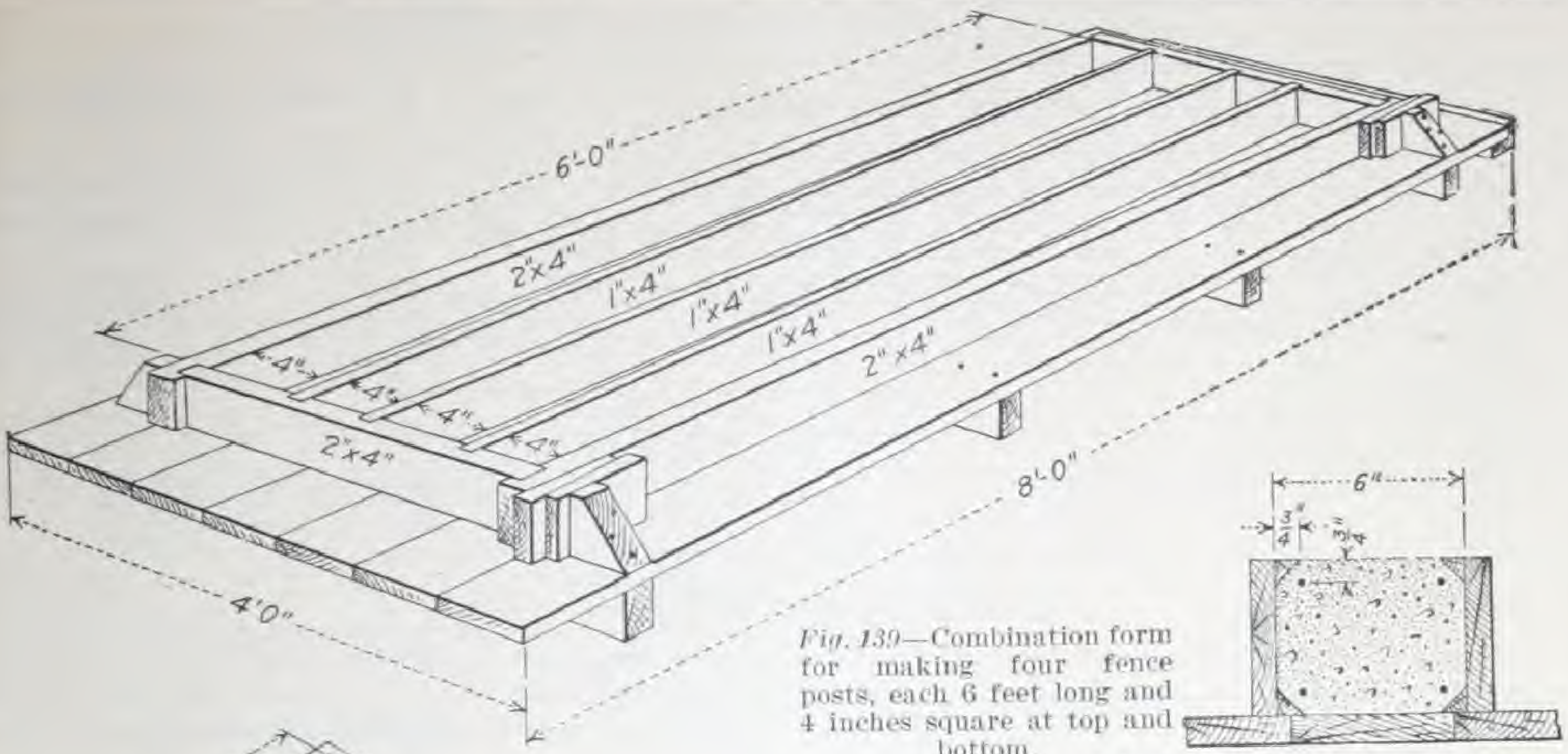


Fig. 139—Combination form for making four fence posts, each 6 feet long and 4 inches square at top and bottom.

Fig. 140—Form, in cross section, for making posts with bevel or chamfered corners.

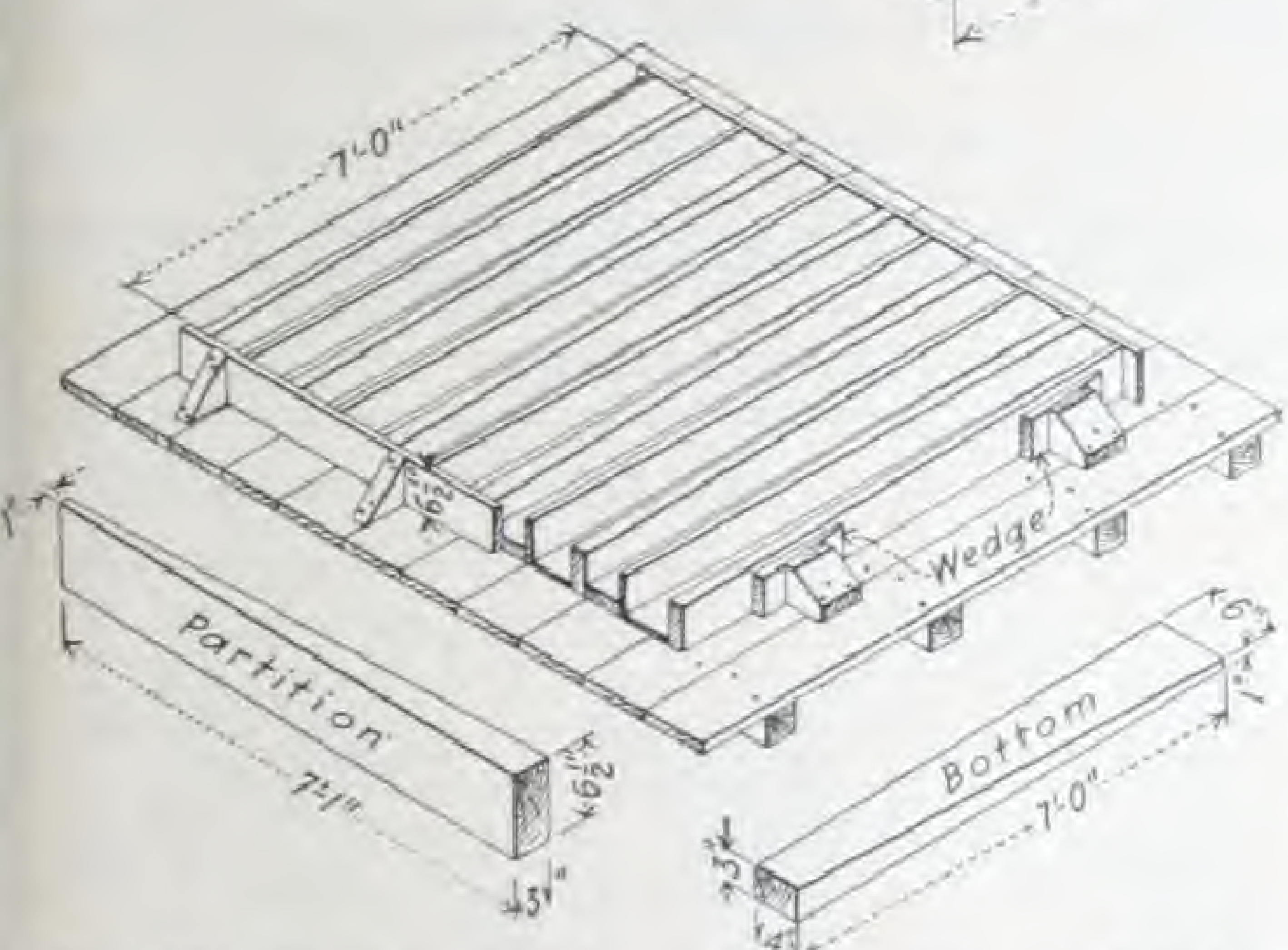


Fig. 141—Combination form with partition and bottom wedges for making taper posts

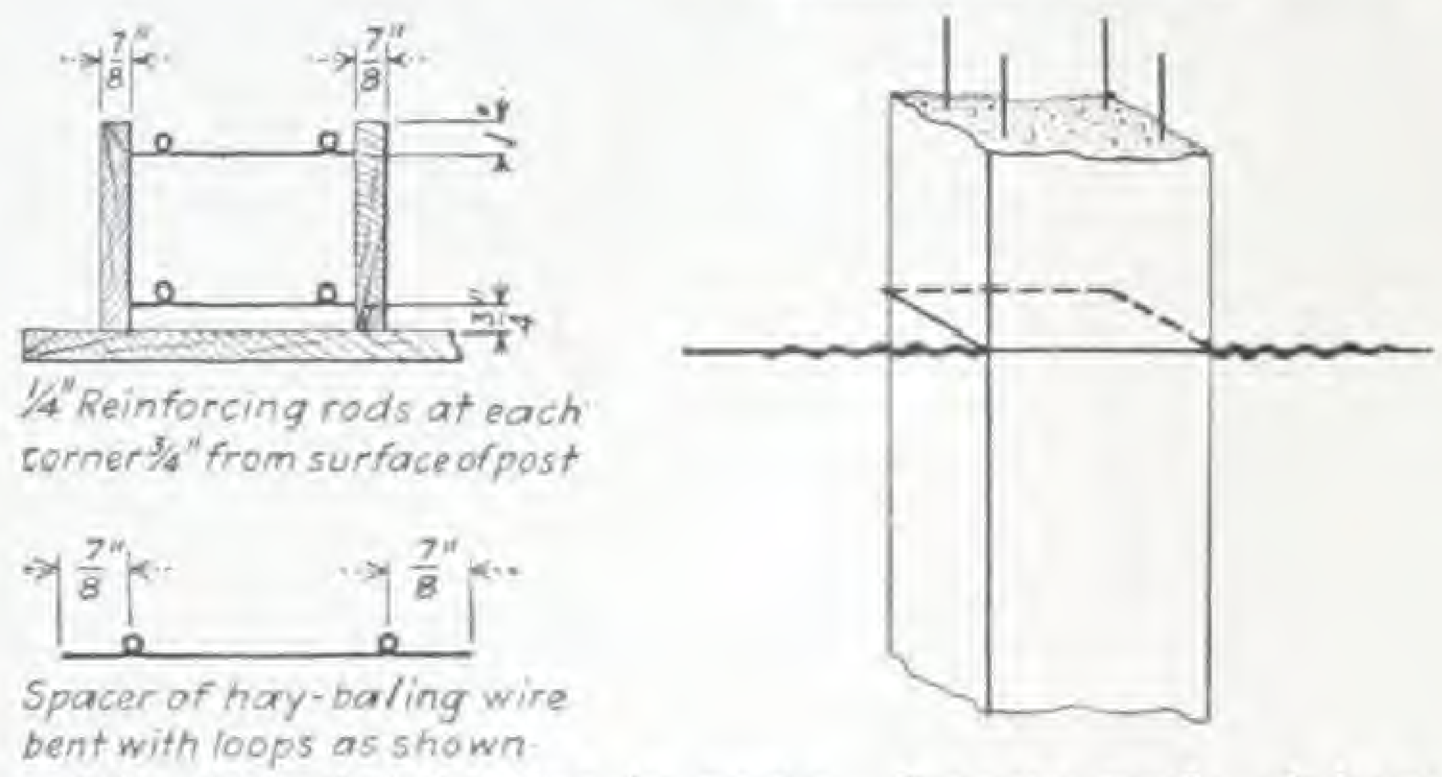


Fig. 142—Reinforcing in posts. Spacers made of hay-baling wire. To the right, a simple way of tying the wire fence to the post.

Fig. 143—Corner post double-braced. The eye bolts through the post hold rods to which the woven wire is attached; it may be tightened by screwing up the nuts on the opposite side of the post.

Materials Required for 10 Posts, Different Sizes

Length	Top	Bottom	Cement	Sand	Pebbles	Reinforcement
6 ft. 6 in.	3 in. sq.	5 in. sq.	2 bags	4 cu. ft.	6 cu. ft.	40 1/4-inch round rods—4 for each post.
7 ft.	"	"	2 "	4 "	6 "	
7 ft. 6 in.	"	"	2 1/5 "	4 2/5 "	6 3/5 "	
8 ft.	"	"	2 1/3 "	4 2/3 "	7 "	
6 ft. 6 in.	4 in. sq.	5 in. sq.	2 1/3 "	4 2/3 "	7 "	40 5/16-inch round rods—4 for each post.
7 ft.	"	"	2 1/2 "	5 "	7 1/2 "	
7 ft. 6 in.	"	"	2 3/4 "	5 1/2 "	8 1/4 "	
8 ft. 6 in.	"	"	3 "	6 "	9 "	
6 ft. 6 in.	5 in. sq.	5 in. sq.	3 1/2 "	7 "	10 1/2 "	40 3/8-inch round rods—4 for each post.
7 ft.	"	"	3 4/5 "	7 3/5 "	11 2/5 "	
7 ft. 6 in.	"	"	4 "	8 "	12 "	
8 ft.	"	"	4 1/3 "	8 2/3 "	13 "	

Corner posts and gate posts

Corner posts and gate posts are subject to far greater strains than line posts. Corner posts must withstand practically the entire pulling strain of the fence from two directions. The gate posts have to withstand the strain of the fence and also of the gate. These posts must, therefore, be much heavier and be more strongly reinforced than the line posts.

Corner posts on account of their size and weight, are best made in place. Excavate a hole for the part which is below ground, and build a form as shown in Figure 147 for the section above ground. Place the reinforcing—be sure it goes down to the bottom of the hole—and pour the concrete from the top.

The following table gives the reinforcement and the amounts of material needed for corner posts and gate posts:

Materials Required for Four Corner Posts, Different Sizes

Length	Size	Cement	Sand	Pebbles	Reinforcing
8 feet	6 in. sq.	2 bags	4 cu. ft.	6 cu. ft.	16 1/2-inch round rods—4 for each post.
8 feet	7 in. sq.	2 4/5 "	5 3/5 "	8 2/5 "	
8 feet 6 in.	"	3 "	6 "	9 "	
8 feet	8 in. sq.	3 3/5 "	7 1/5 "	10 4/5 "	16 5/8-inch round rods—4 for each post
8 feet 6 in.		4 "	8 "	12 "	
9 feet		4 1/5 "	8 2/5 "	12 3/5 "	
8 feet	10 in. sq.	5 4/5 "	11 3/5 "	17 2/5 "	16 3/4-inch round rods—4 for each post.
8 feet 6 in.		6 1/5 "	12 2/5 "	18 3/5 "	
9 feet		6 2/5 "	12 4/5 "	19 1/5 "	

Fig. 144—Working on a concrete corner post. The reinforcing rods are embedded in the foundation.

Fig. 145—Working on a concrete corner post. Filling the form and steadying the reinforcing rods.

Fig. 146—A concrete gate po showing adjustable iron hoop ho ers for hinges.

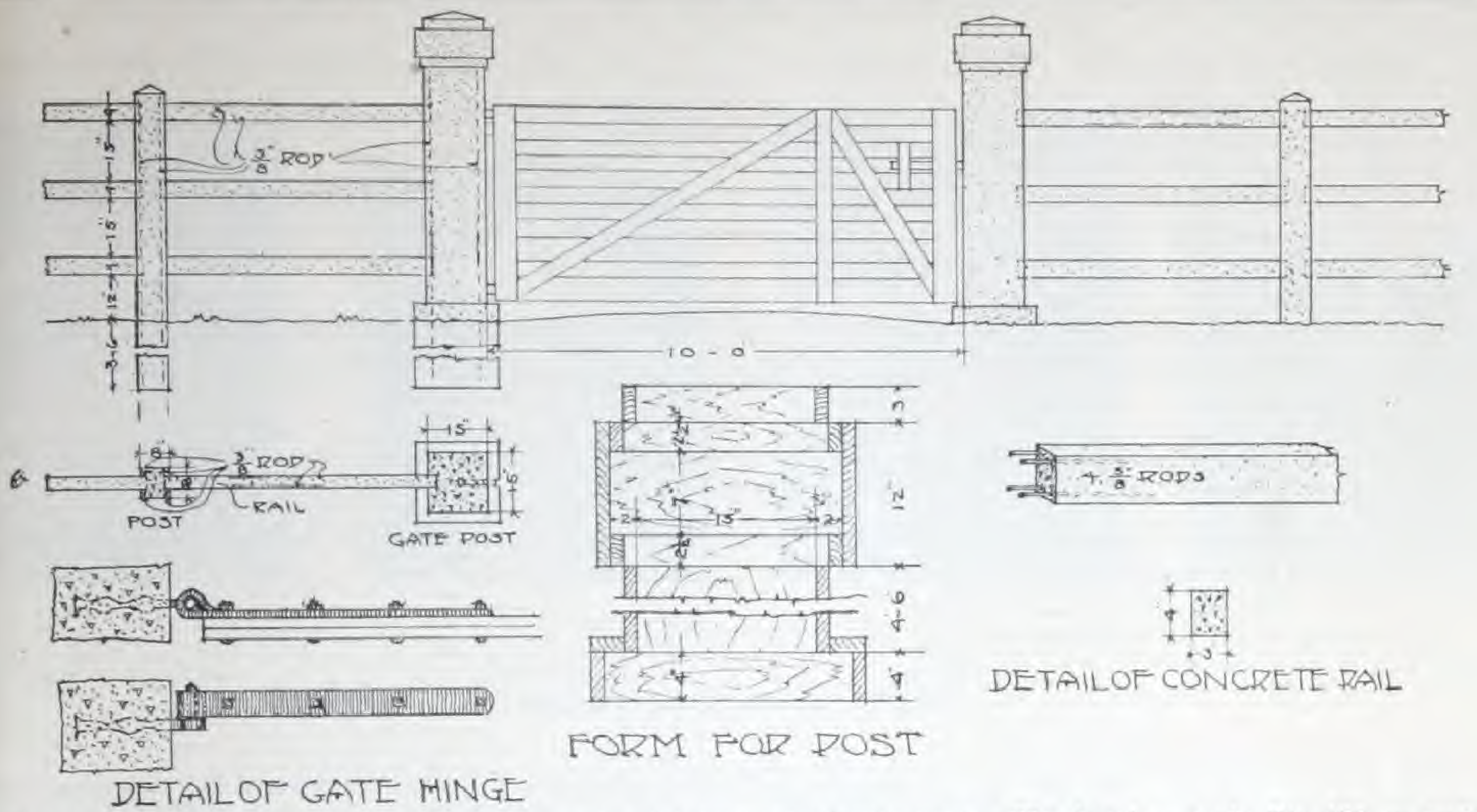


Fig. 147—At the top, general construction and reinforcement of gate posts. The bracing, as in Fig. 156 on page 73, and one way of anchoring a gate hinge—see also Fig. 146. In the center the form for the posts. To the right, the reinforcement and the dimensions of a concrete rail.

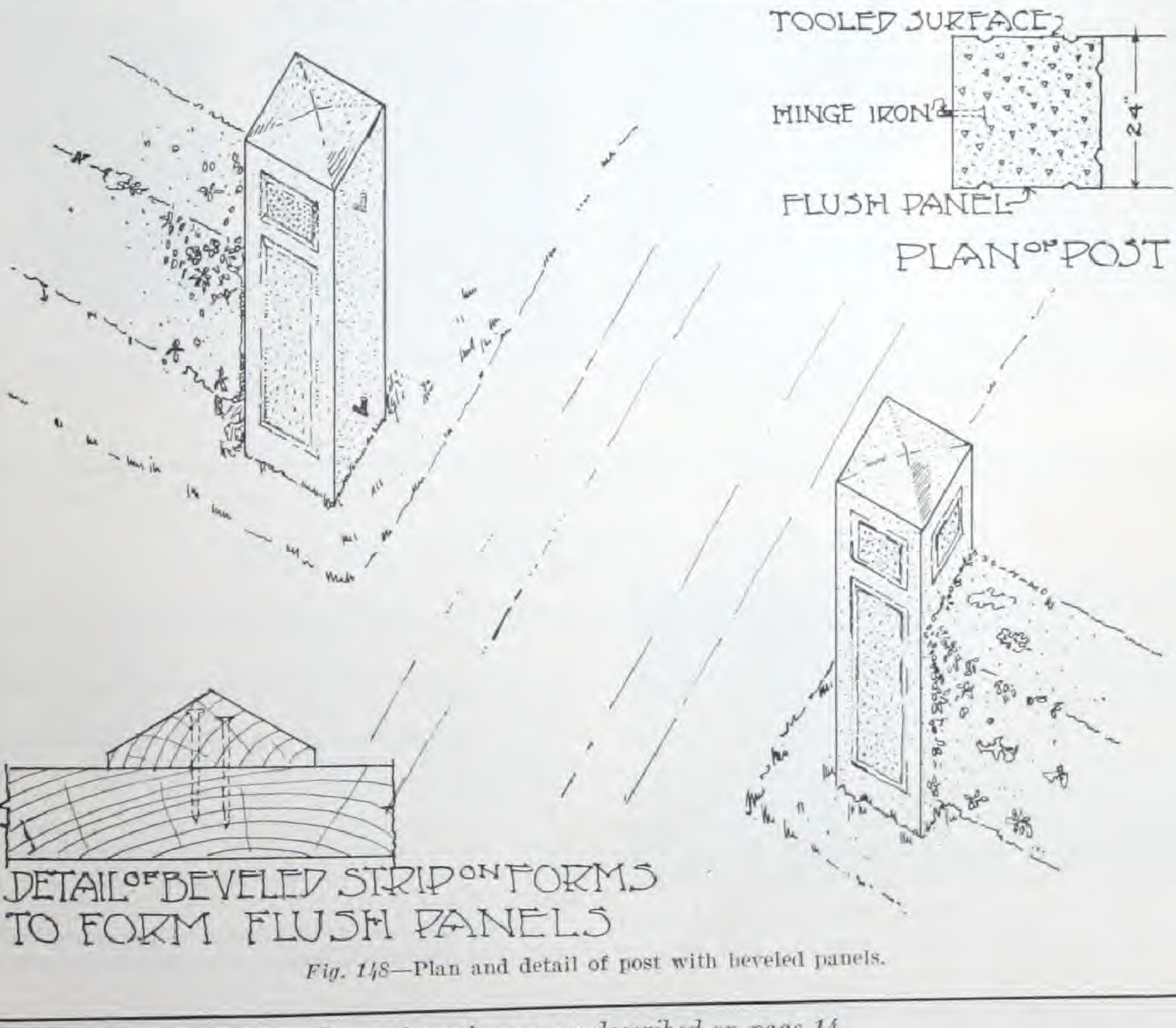


Fig. 148—Plan and detail of post with beveled panels.

Forms for columns are described on page 14.

Bracing heavy posts—Even though corner posts and gate posts are very heavy, it is usually wise to brace them in the direction of the pull. These braces are best made out of concrete, so that they will be as lasting as the posts. See Figures 143, 155 and 156.

The braces should always extend in the direction of the strain from fencing. A simple method of making them is to use one of the small line posts set with one end in the corner post and the other in the ground, resting against a block of concrete in the ground.

Gate posts can be given a handsome appearance by simple ornamentation, such as panels in the sides and ornamental tops. These panels are made by nailing boards to the inside of the forms. See Figure 148 on the preceding page.

Hinges for gates can be attached to the posts in several ways: rods can be placed through the forms so that holes will be left, and the hinges bolted through the post; or one end of the hinge, with a washer in the end, may be placed in the soft concrete as shown in Figure 147, or on a circular post adjustable hoop holders may be placed as in Figure 146 on page 70.

Other concrete posts

For any sort of posts that can be made of wood, concrete can be used and it will have the advantage of being stronger, more permanent, and neater, and will require practically no attention or care—provided only that the concrete posts are made carefully of well chosen aggregates and that the posts are properly cured and put into the ground right.

The possibilities of concrete in this direction are manifold and various. We are constantly hearing of some new use for concrete devised by an ingenious farmer. You will probably think of other sorts of posts besides those mentioned below which can be built of concrete.

Hitching posts are easily made of concrete and are similar to fence posts. A ring is attached to them either by leaving a hole through the post near the top, or by placing an eyebolt in the top while the concrete is still soft. Such a post is shown in Figure 149.

Mail-box posts of concrete are permanent and ornamental, and give an air of dignity to the farm. They are constructed like fence posts. Two different types are shown in Figures 150 and 151.

Clothesline posts of concrete are permanent and clean, and will not sag if they are properly placed. These posts are made and reinforced like long fence posts. Place an eyebolt in the concrete while it is still soft, to provide for attaching the clothesline.

Hog troughs and feeding troughs

Substantial and permanent feeding troughs are best made of concrete—and they are easy to build.

Forms—Build a bottomless box on the ground, 6 feet long, 12 inches wide and 12 inches deep. Stake the sides and ends with 2-by-4 uprights. Take two-6-inch boards each 5-feet-6-inches long, and nail them together at right angles. Cut a triangular block to fill in the end as a support for right angle form. This is shown in Figure 158. Place this inside the form with angle up. If a round bottom is desired, cut a log 9 inches in diameter and 5 feet 6 inches long and saw it down the middle. Peel the bark and smooth the log. Use this (round side up) for the inside form, supporting it on two 2-by-4's, 5 feet 6 inches long, to give the trough the right depth. See Figure 157.

Grease the form thoroughly and place the concrete mixed in the proportion of 1 part Atlas, 2 parts sand, and 4 parts stone or gravel.

Reinforce the concrete with chicken wire, as shown by the curved lines in Figures 157 and 158. After the concrete has hardened, remove the outside form, turn right side up, and remove the inside form.

These troughs require approximately 1 bag Atlas Cement, 2 cubic feet of sand, and 4 cubic feet of stone or gravel each.

For mixing concrete, see pages 10 and 11.

Fig. 149—A neat six-sided hitching post of concrete slightly tapered.

Fig. 150—A concrete mail-box post with regulation metal box.

Fig. 151—Concrete mail box and post—a very individual design.

Fig. 152—Concrete line post with fencing held by wire rod through eyebolts.

Fig. 153—Corner post in concrete — individual wires carried around and tied.

Fig. 154—Square concrete post with very heavy double bracing on one side.

Fig. 155—Braced post pierced for wires and for eyebolts to hold rod on which wires are fastened.

Fig. 156—Small post with double rail bracing like detail in Fig. 147.

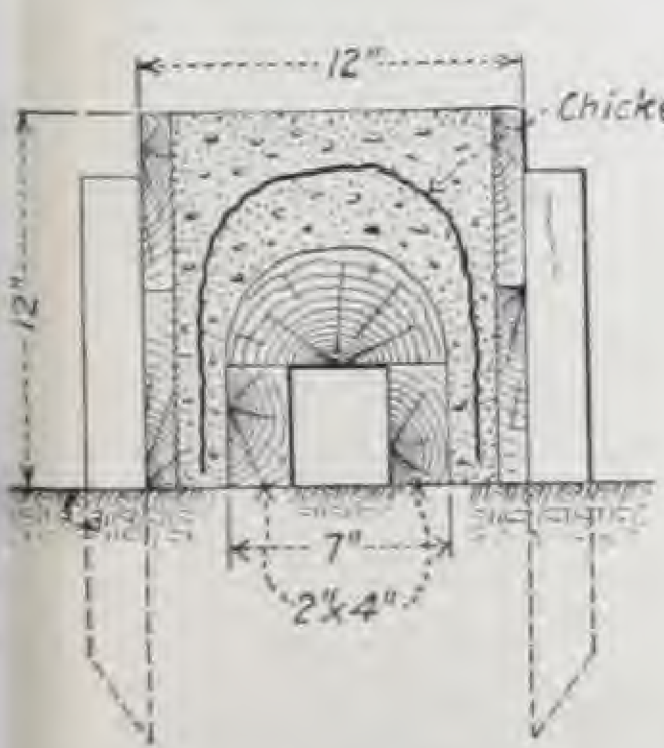


Fig. 157—Form for trough with rounded inside.

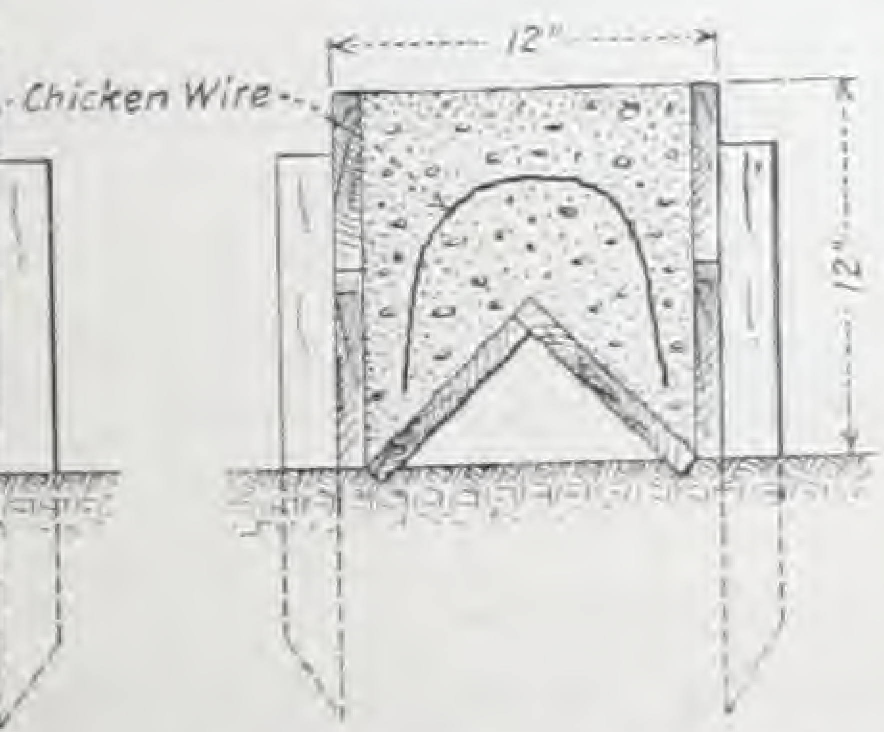


Fig. 158—Form for trough with angular bottom.

Fig. 159—Concrete feeding trough with flap corners.

Concrete retaining walls

Retaining walls are best built of concrete, because this form of construction is so simple and permanent, and the materials are more readily procurable everywhere than anything else that is suitable for heavy masonry construction.

There are various kinds of retaining walls, but we will deal here only with the simplest type, which is known as the gravity retaining wall and does not require reinforcement. It is the most economical, especially for walls less than 20 feet high.

How to build retaining walls

The foundation is of prime importance. A good footing must be obtained, as a settlement of only a few inches might cause failure. Excavation should be carried below the frost line, which means 3 or 4 feet. Sand and gravel make good foundations when they are dry and well packed. If the soil is soft, you will have to dig deeper and fill in with gravel or cinders thoroughly packed in place.

Sizes—The wall is made widest at the bottom to give stability, and slopes gradually to the top. The slope is usually on the side against the earth. The front of the wall, however, is also sloped slightly so that the top will not seem to be tipping out. In Figure 162 is shown a cross section of a retaining wall and dimensions for various parts, all in terms of the height of the wall.

The thickness of the base of the wall should be four-ninths of the height. The top should be 18 inches thick, no matter what the height.

Forms are constructed of 1½-inch or 2-inch lumber in accordance with Figure 163, which shows how the struts and bracing are nailed to stakes driven in the ground. As you should avoid horizontal joints in retaining walls, you had better pour the concrete in 12-foot sections. This allows you to use the same form repeatedly.

The mixture should be 1 part Atlas Cement, 2½ parts sand and 5 parts crushed stone. It is possible to save largely on materials by using field stones in the concrete. These may be of any size up to one-half the thickness of the wall and should be placed so that they will be at least 6 inches from the face of the wall, and completely surrounded by concrete. The stones are not mixed with the cement, but placed in it as it is deposited. The stones must be sound, strong and clean; wet them thoroughly before you place them. Use a medium wet mix, and fill the forms to a depth of a couple of feet dropping in the field stones as the concrete is placed in the form. Spade the concrete well next to the forms, so as to secure a satisfactory surface.

Joints—A long retaining wall expands and contracts with the heat, so it must have expansion joints to prevent cracking. These joints should be placed not more than 30 feet apart; they can be placed even closer without weakening the wall. It is best, however, to key these joints together by placing a triangular shaped timber on the face of the end form; see Figure 14, page 12. This leaves a vertical notch in the concrete. The expansion joints should be about ¼ of an inch thick, and it is best to put tar paper in the joints before you pour the next section, as this prevents adhesion of the concrete.

Drainage of water from the earth held by the wall is important. If wet soil is allowed to accumulate water, it soon causes a pressure in excess of what the wall was built to stand. So be particularly careful about drainage. For larger walls, pile stone along the back and bottom of the wall (see Figure 162) to carry away the water.

For a long wall, provide weep-holes 6 to 10 feet apart, by inserting during construction 3- or 4-inch clay pipe near the bottom of the wall, as shown in Figure 162. The back of the wall is then first filled in with stone—a few cubic feet being placed at each weep-hole. For very wet soil, more stone must be used to secure good drainage for back filling the earth. See that the back filling is secure with the soil thoroughly compacted. Deposit it in layers about 8 inches thick, and tamp each layer of earth before the next layer is placed.

Finish—As retaining walls do not have to withstand any pressure during construction, the forms can be stripped as soon as the concrete has set enough to sustain its own weight —in about 3 days. This allows the cheapest and most permanent finishing, that is rubbing with a wood float dipped in water and sand.

A coping is sometimes placed on top of the wall, so as to provide a better appearance than a plain wall (See Fig. 163). It projects 2 or 3 inches beyond the face, and is 12 to 18 inches high, depending upon the top of the wall. The top of the coping should slope slightly backward in order to prevent water from draining over and discoloring the face of the wall. To bevel or round the cornice of the coping, use a triangular strip or a cove molding in the forms as shown in small detail of Figure 163.

Barn approaches of concrete

A solid, substantial and permanent approach to the doorway of a basement barn may be best built of concrete. Such a construction is shown in Fig. 164. It consists of two side walls, which should be built according to the instructions given on this page for small retaining walls. The slab which bridges a passageway directly in front of the basement may be built of wood. If this slab is constructed of concrete, it must be 6 inches thick and should be well reinforced.

Summary of directions for choosing aggregates on page 6.

Fig. 160—Concrete wall along ditch by roadway.

Fig. 161—A large concrete retaining wall on a steep hillside.

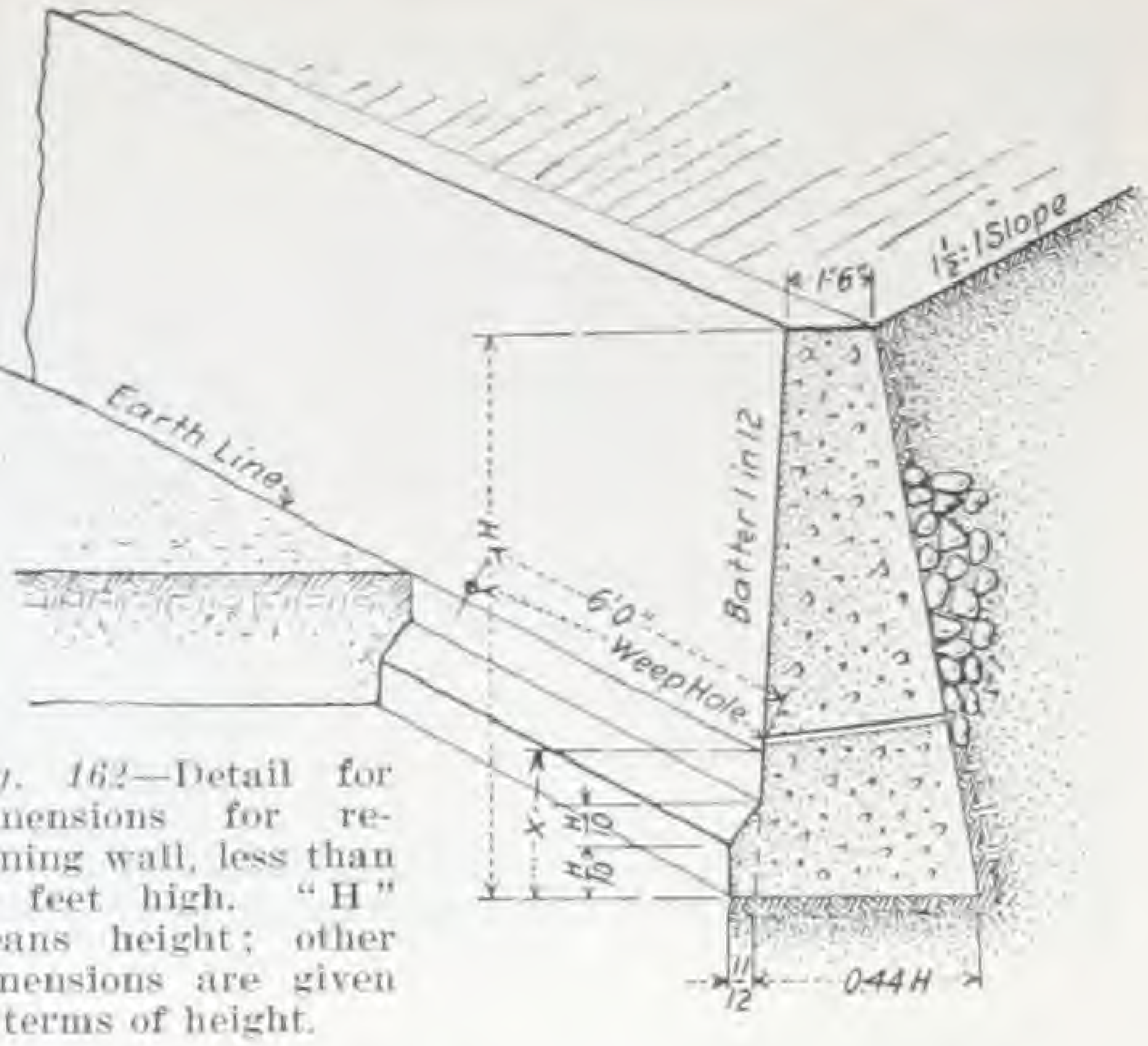


Fig. 162—Detail for dimensions for retaining wall, less than 20 feet high. "H" means height; other dimensions are given in terms of height.

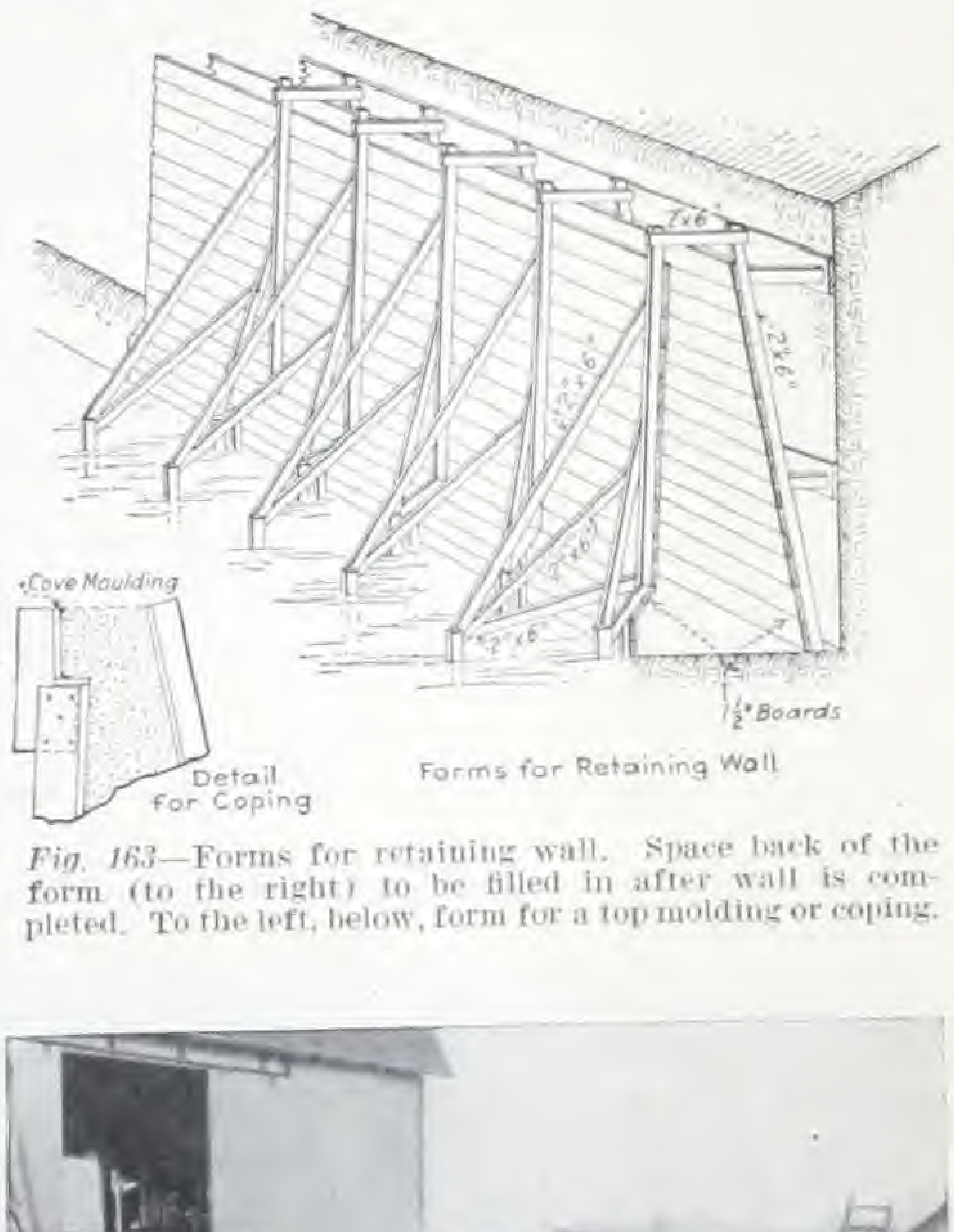


Fig. 163—Forms for retaining wall. Space back of the form (to the right) to be filled in after wall is completed. To the left, below, form for a top molding or coping.

Fig. 164—Concrete approach to barn, with wooden platform for bridge over surface passageway.

Farm ditch of concrete

The economy of farm drainage is well known. Wet lands are not only unsightly but unprofitable, and are breeding places for mosquitoes and other insects that spread malaria and cause discomfort. The simplest remedy is a drainage ditch. The best possible material for the drainage ditch is concrete—and it has the additional advantage of convenience and ease in construction.

The bottom of the ditch may be floored with large cobblestones imbedded in the concrete roughly. Figure 165 shows dimensions for the construction of a concrete ditch 2 feet wide at the bottom and 3 feet deep. For the side walls, inside forms can be constructed, as described under forms on page 13; no outside forms are needed unless the soil is loose and damp.

Mixture—Use 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone.

Construction—See that the aggregates are carefully selected (see page 6), and in placing employ all the possible precautions for getting a watertight concrete (see page 17). Follow the general directions in this book for foundations (page 20) and walls. With careful construction the ditch will need no finish other than rubbing with a wooden float (see Fig. 21, page 16).

Drain tile of concrete

Draining low lands with tile is one of the most promising and successful methods of conservation. It is better than ditch drainage because it permits the use of the entire field for cultivation.

Concrete is the best material for drain tile—being less brittle than clay or shale and far less likely to freeze—and is resistant to the chemical action of alkaline ground water.

If you buy drain tile ready made—be sure to get concrete tile. It is well made by many manufacturers.

Making concrete drain tile for yourself is easy and economical winter work on the farm. You can do it under cover at a time when there is little work to do—and this will give you plenty of time to cure the tile properly.

A great variety of simple machines for making drain tile of concrete are on the market—and it is better to buy one of these if you have many tile to mold.

Figure 167 shows a home-made mold of easy manufacture, should you want only a few tile. Grease the mold to prevent concrete sticking.

Mixture—Use 1 part Atlas Cement and 3 parts coarse, well graded sand, screened through a sieve with meshes measuring one-half the thickness of the wall of the tile—that is ½-inch mesh for tile with 1-inch walls.

Spring boxes

The spring as the source of drinking water supply is so easily contaminated by animals that it should be enclosed. Wood, used for this purpose, lasts only a short time. Concrete lasts forever and is sanitary. It is so substantial that even the larger animals cannot harm or disturb it.

Temporarily divert the outflow of the spring if possible, and excavate a ditch about 12 inches deep, enclosing the entire spring. Build the walls 6 inches thick, making them of a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts stone or gravel. (See page 13 for wall forms.) Bring the top of the wall about 12 inches above the water.

Build a cover 5 inches thick for the spring box, following instructions for cistern covers on page 60. Make this at one side, on a temporary platform and slide it into place afterward. Then you won't have to place any forms in the spring.

Quantities required—For a box 3 feet square, with foundations 12 inches below ground, walls 6 inches thick and 18 inches above ground, and a cover 5 inches thick, you will need 3 bags Atlas Cement, 6 cubic feet sand, and 12 cubic feet gravel.

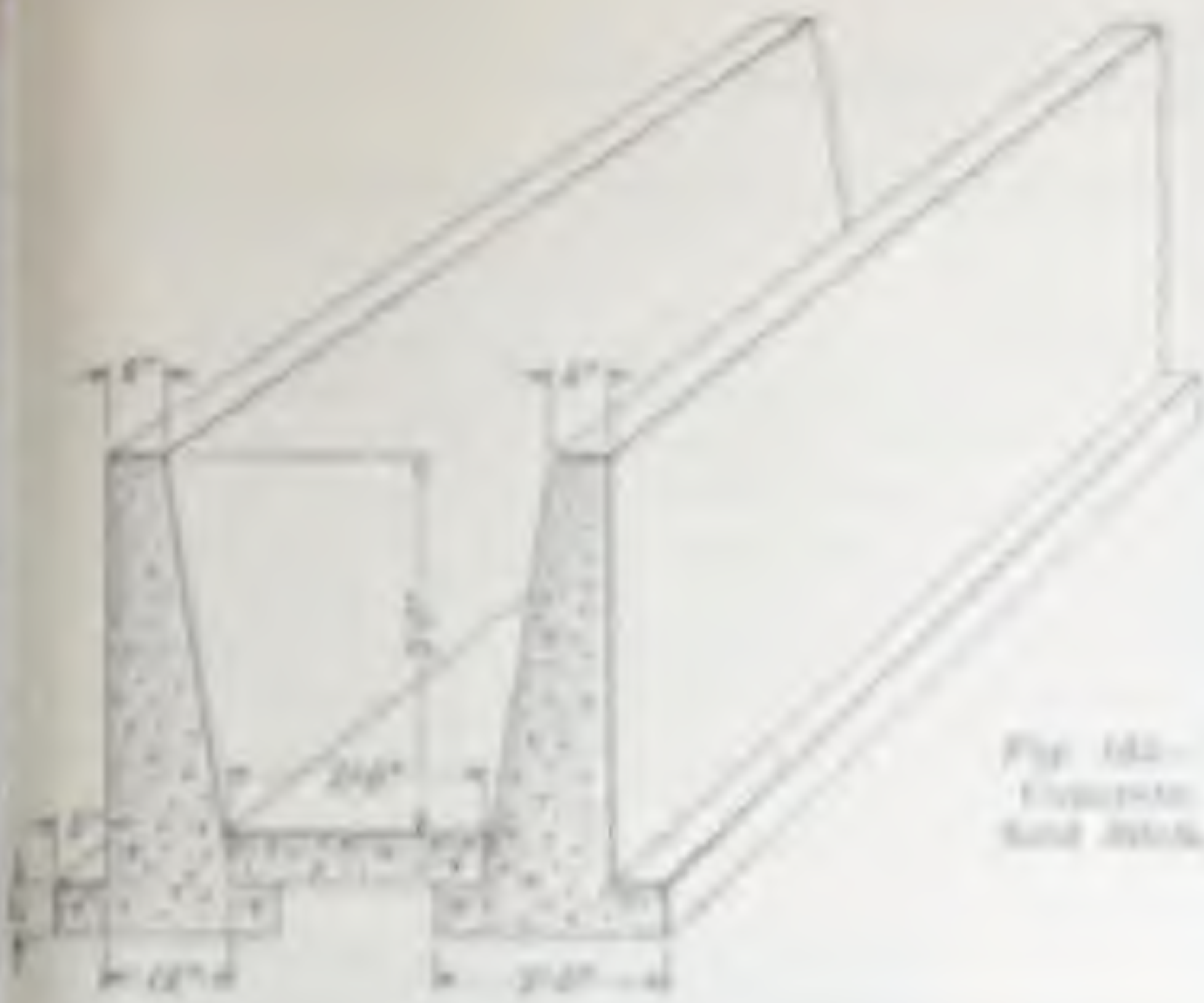


Fig. 195—Concrete Head Ditch.

Fig. 196—Part of a two-mile long flume of concrete.

Fig. 197—To the right, machine for drain tile. The table, 18 inches square, 30 inches high has a 4-inch hole in the centre for the core, and 14 inches below the top for the core handle, and to support a lever which fits a notch in this handle and keeps the core raised while the tile is being made. The pallet, 8 inches square, with cleats on the bottom and a 4-inch round hole in the center is placed over the core on the top of the table, the core sticking up the length of the tile. Have a pallet for each tile you expect to make in a day. Then lock together the outside form (made by a local tinsmith from a piece of sheet iron 12 by 20¼ inches, so that the outside diameter is about 5½ inches) and place the core on the pallet. After the concrete has hardened sufficiently, release the lever from the notch in the handle of the core and tap the top of the core lightly. Have some old bags under the end of the handle so that the jar will not disturb the tile. Then unlock and remove the outer mould. Store in a damp place. Leave the tile on the pallets for 24 hours.

This apparatus is for a tile 12 inches long and 4 inches inside diameter, but any size can be made by changing the dimensions.

Fig. 198—Concrete curb around a flowing well.

Fig. 199—Square concrete box covering a flowing well.

Lawn and farm rollers

A form for making a concrete roller is very easily and cheaply made, as shown in Figure 170A and such a roller is a very convenient thing to have on the farm.

For a roller 18 inches in diameter, and 24 inches long, cut a piece of sheet-iron 24 inches by 56¼ inches. The edges must be cut even and must be square. Make two sets of wood clamps like the circular forms shown in Fig. 170A. The piece of sheet-iron, cut to the dimensions as given, can now be bent in a circle and nailed, if necessary, to the wood clamps. Wind the iron form or jacket with No. 16 wire to hold the form from opening at the joint when the concrete is placed. A piece of tile sewer pipe of the right size also makes a very good mold.

Grease or oil the inside of the form thoroughly so that it will not stick to the concrete. To make an opening through the center of the roller for an axle or shaft, place a ¾- or ⅞-inch iron pipe in the center of the form. The axle can be cast to the roller itself if desired, instead of casting the pipe in the roller and putting the axle through the pipe. The concrete should be made of 1 part Atlas Cement, 2 parts sand, and 4 parts stone or gravel. It will take a little less than 1 bag of cement, 2 cubic feet of sand and 4 cubic feet of stone or gravel, for a roller of these dimensions.

Sun dials

Concrete lends itself very well to the construction of sun dials as it gives a permanent and rigid structure.

You can use cement throughout—or stones laid up in a cement mortar, as in Figure 171.

Excavate to secure a good firm footing, below frost line, so that the structure will not be tipped by the action of frost. Ordinary field stones are used and these are laid up in a mortar composed of 1 part Atlas Cement and 3 parts of sand. When the desired height has been reached the work is levelled off and the sun dial proper put in place. A top surface is then put on of the same mixture of Atlas Cement and sand, to a smooth finish.

A concrete dial may be built with either a square or round base or post—in accordance with instructions on posts, pages 68-72.

Horse and auto blocks

Horse blocks of concrete can be built solid right in place.

Form—Use a box without a bottom, 36 inches long, 18 inches wide and 12 inches deep, inside dimensions. Grease this form and fill with concrete.

Mixture—Use 1 part Atlas Cement, 2 parts clean coarse sand, and 4 parts screened gravel or broken stone. This will take 2 bags of Atlas Cement.

The top surface should be smoothed off with a trowel. Remove the form the next day, or as soon as the concrete is hard enough not to show thumb marks. While the concrete is green, rub down the sides with a wood float or a cement brick. Keep the block damp for a week by sprinkling it daily.

Rain leaders

Rain leaders or gutters are best constructed of concrete because concrete is durable and attractive, cheap, and easy to construct.

Excavate a trench 6 inches deep by 24 inches wide from the end of the rain conductor to the required distance from the building—usually about 4 feet. Pack the earth thoroughly. You will not need forms—only 2-by-4-inch boards at the sides of the trench, held in place by occasional stakes. See Figure 173.

Mix a small batch of concrete, in proportions of 1 part Atlas Cement, 2 parts sand, and 4 parts gravel or crushed stone, and fill the trench with 5½ inches of concrete. Hollow out the surface of concrete with the template shown in Figure 173, and trowel it a little to form the trough.

Grape arbors and pergolas

Posts for grape arbors may be built artistically and permanently of concrete. Figure 174 on the opposite page will give you an idea of the beauty of concrete grape arbors. These posts are made in the same manner as fence posts and are usually about 6 inches square and about 10 feet long.

The amount of reinforcement and material required are given in the table on page 70. See directions for making posts on pages 68-73.

An artistic trellis or pergola may easily be built of concrete posts made in the same way.

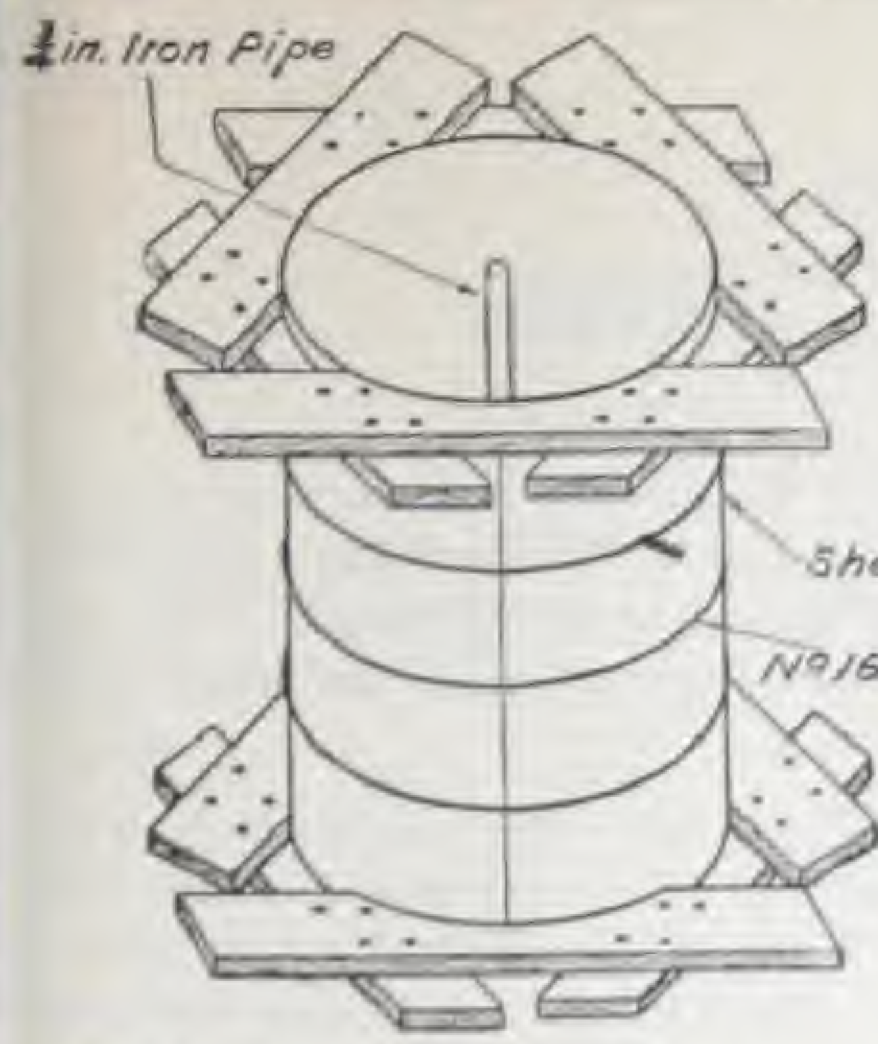


Fig. 170A—Circular form for a concrete roller.

Fig. 170B—The complete roller ready for actual use.

Fig. 171—A sun dial of field stone in cement mortar with concrete top finished with mortar.

Fig. 172—A solid concrete horse block with concrete hitching post and sidewalk.

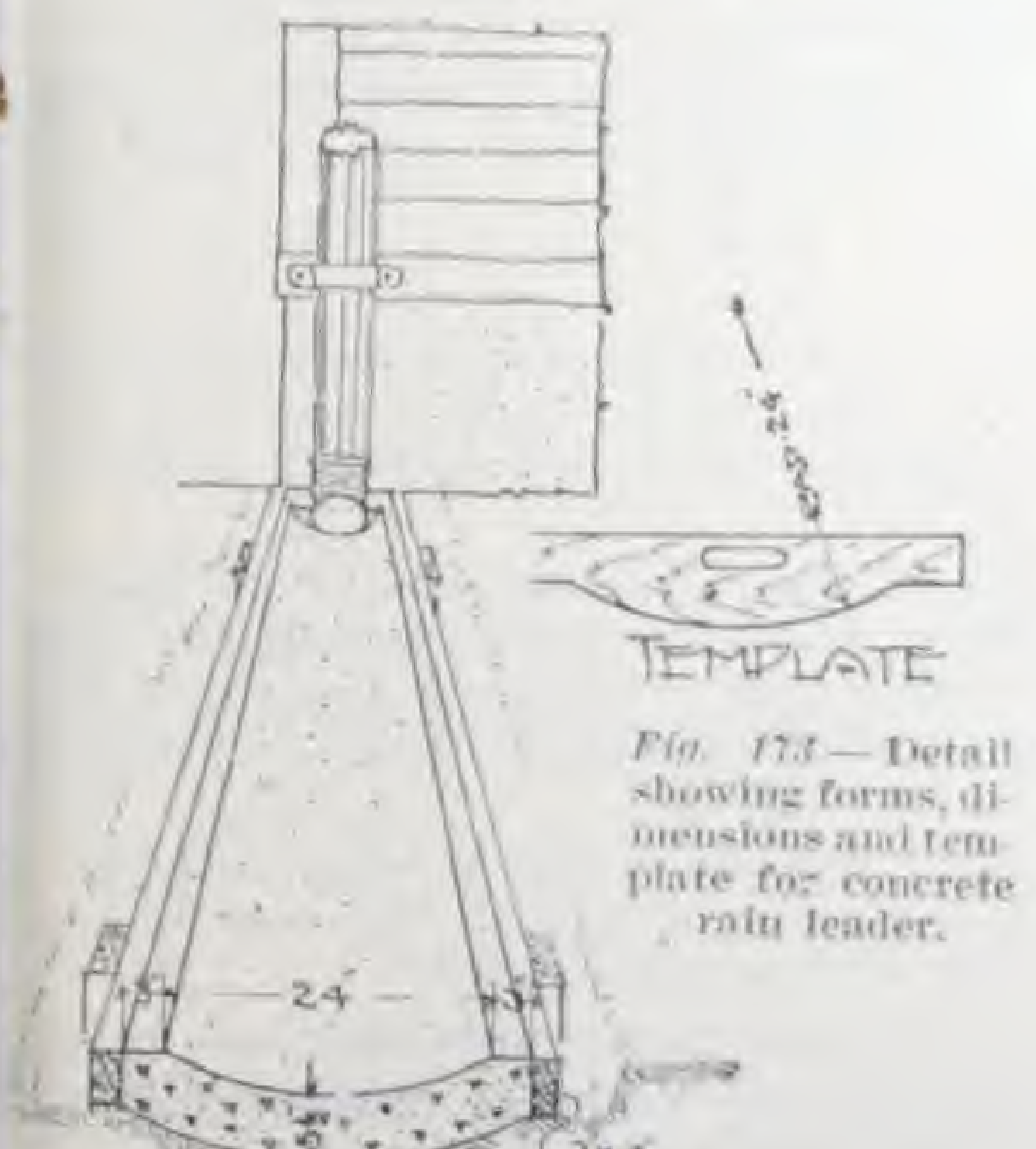


Fig. 173—Detail showing forms, dimensions and template for concrete rain leader.

Fig. 174—Grape arbor with permanent and handsome pillars built of concrete.

Septic tanks

There is nothing that is such a nuisance or so positively dangerous to health as the ordinary outside privy on the farm or in the small town. It is not only unpleasant, due to its odor and the flies it breeds, but it spreads diseases such as typhoid, dysentery and hookworm. A cesspool is little better, as it must be cleaned out often and it is difficult to dispose of the contents satisfactorily.

The concrete septic tank provides a sanitary and practical method of disposing of house sewage. It allows the use of bath-tubs and water-closets in the house. The kitchen sink also can be drained into it.

A septic tank is a covered concrete tank divided into two compartments, one larger than the other. The sewage enters the large compartment and the solid matter floats to the surface. The tank, being dark and warm, is an ideal breeding place for bacteria, little germs that eat up and destroy the solid matter. This action takes place in the first chamber. The purified liquid then passes through the partition into the smaller compartment, from which, when it gets to a certain level, it is automatically siphoned off into drain tile, laid with open joints, from which it seeps into the ground.

How a concrete tank is built

Figure 177 shows the layout of a septic tank. A 4-inch sewer line runs from the house to the tank. This inlet line is laid with tight joints and enters the tank with an elbow so that the waste enters below the water surface of the larger chamber. This is to prevent the rush of water from disturbing the scum which forms on the surface and which must not be broken up or disturbed if the bacterial action in this chamber is to be complete. Two baffle boards, placed across the tank (see the diagrams) help prevent the scum being disturbed. As the water rises in the large compartment, it flows through an inlet pipe into the small compartment from which at certain intervals, about 4 to 6 hours, it is automatically siphoned off into the disposal drain. (Siphons can be procured from local hardware dealers.) The disposal drain is made of 4 inch pipe laid with tight joints up to the ends of the four branches. The branches are laid with open joints (see details on page opposite) about 18 inches below the surface of the ground. The length of these disposal lines depends upon soil conditions and the number of persons in the house. For sandy soil allow about 35 feet for each person served and in loamy soil 60 feet. The tank described in this article is for eight persons, so that it will require a total length of unjointed drain of 280 feet for sandy soil, or 480 feet for loamy soil. This length can be divided between four or six lines as desired. The layout is shown in Figure 177.

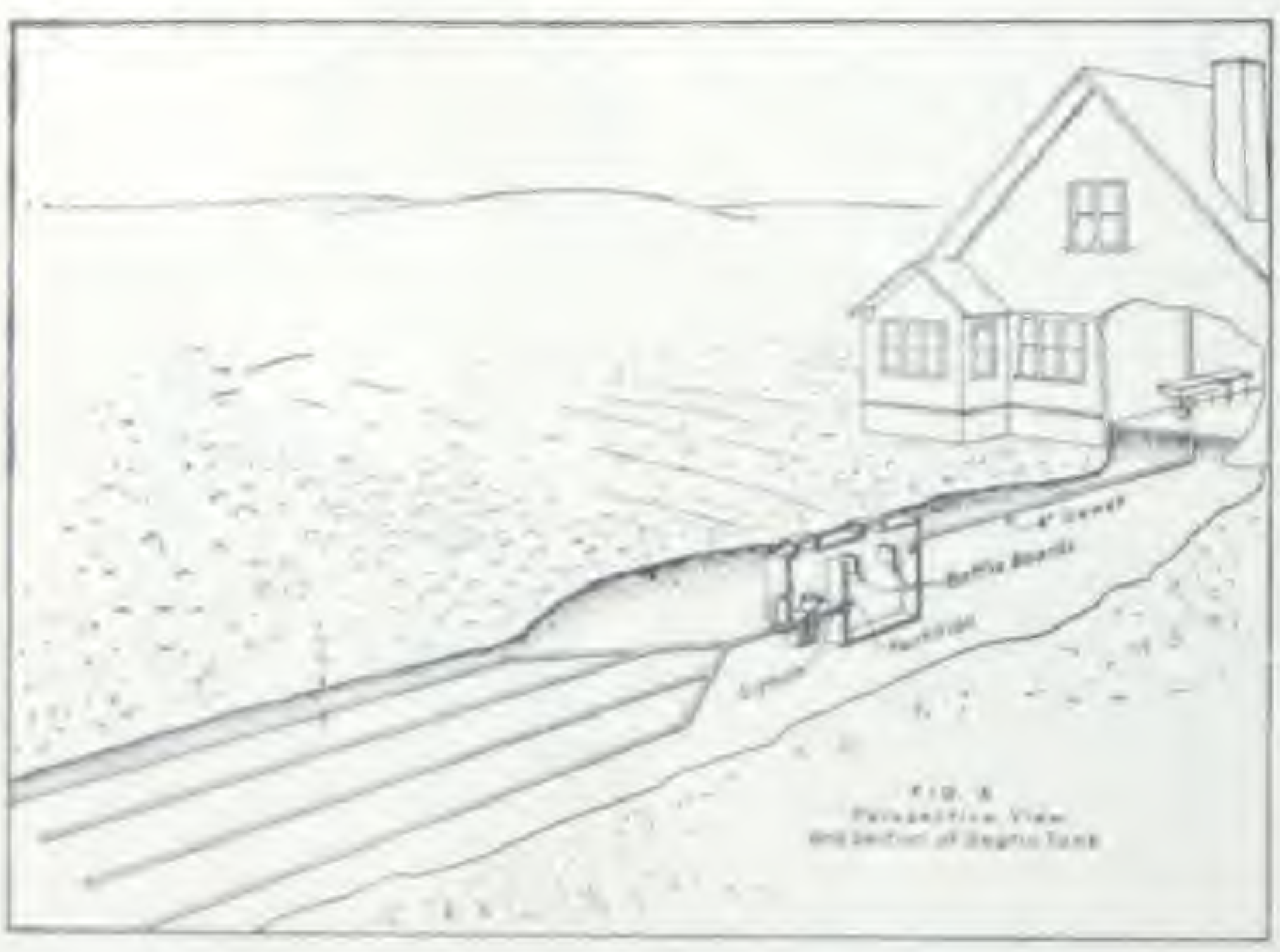


Fig. 177—Perspective and elevation of septic tank.

If the soil is gumbo or clay, a rock filled ditch (see detail) will have to be used as shown in Figure 180. Allow 60 feet of this drain for each person served. Figure 179 shows the tank complete with the exception of the roof. The reinforcing bars projecting from the walls are bent over into the cover.

The construction of the forms for the tank is the same as for the tank shown on page 57 in Figure 116. The concrete is mixed in the proportions of 1 part of Atlas Cement, 2 parts of sand, and 3 parts of stone. This size tank will require 44 bags of Atlas Cement, 88 cubic feet of sand and 132 cubic feet of stone or gravel. The roof is reinforced with ¾-inch round rods, spaced 6 inches apart each way, 1 inch from the bottom. The covers are reinforced with chicken wire and an eyebolt is cast in the cover so that it can be easily removed.

Note—The tank must be constructed with the greatest care, or it will require frequent cleaning and will be otherwise unsatisfactory.

General information on reinforcement is on page 18.

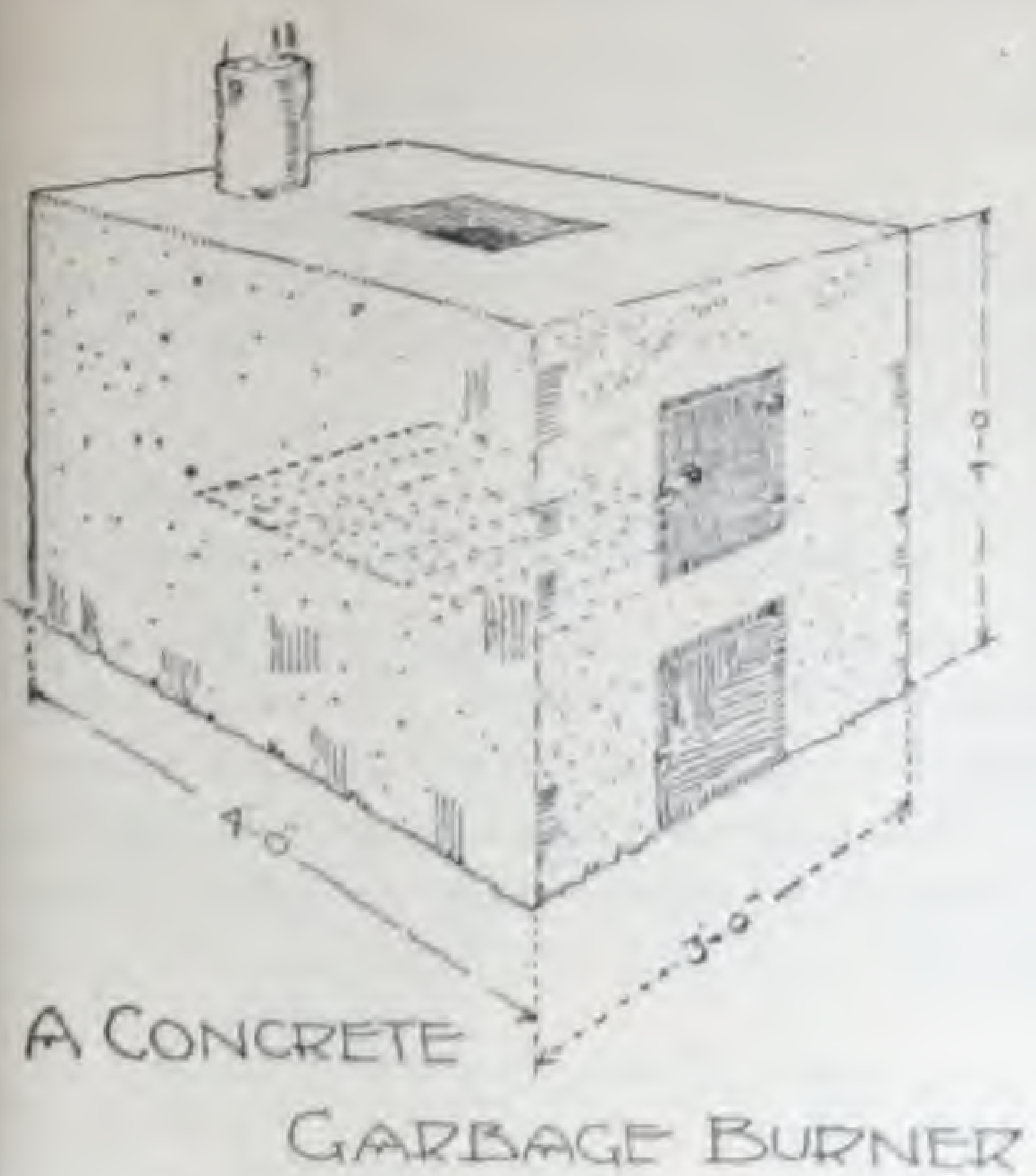
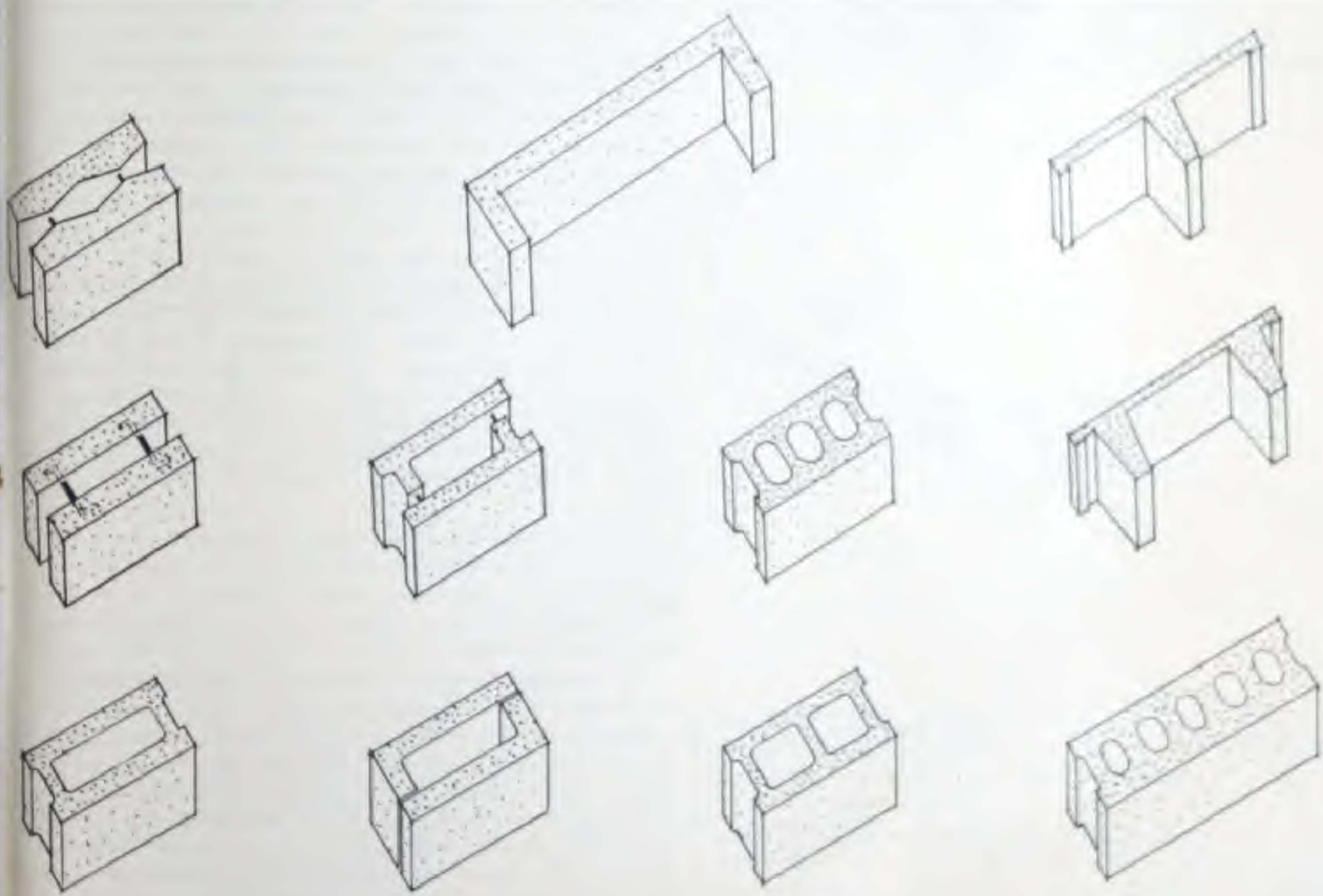


Fig. 175—Method of construction.

Fig. 176—Concrete feed cooker or syrup evaporator.



SOME DIFFERENT TYPES OF CONCRETE BLOCKS

Septic tanks

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How a concrete tank is built

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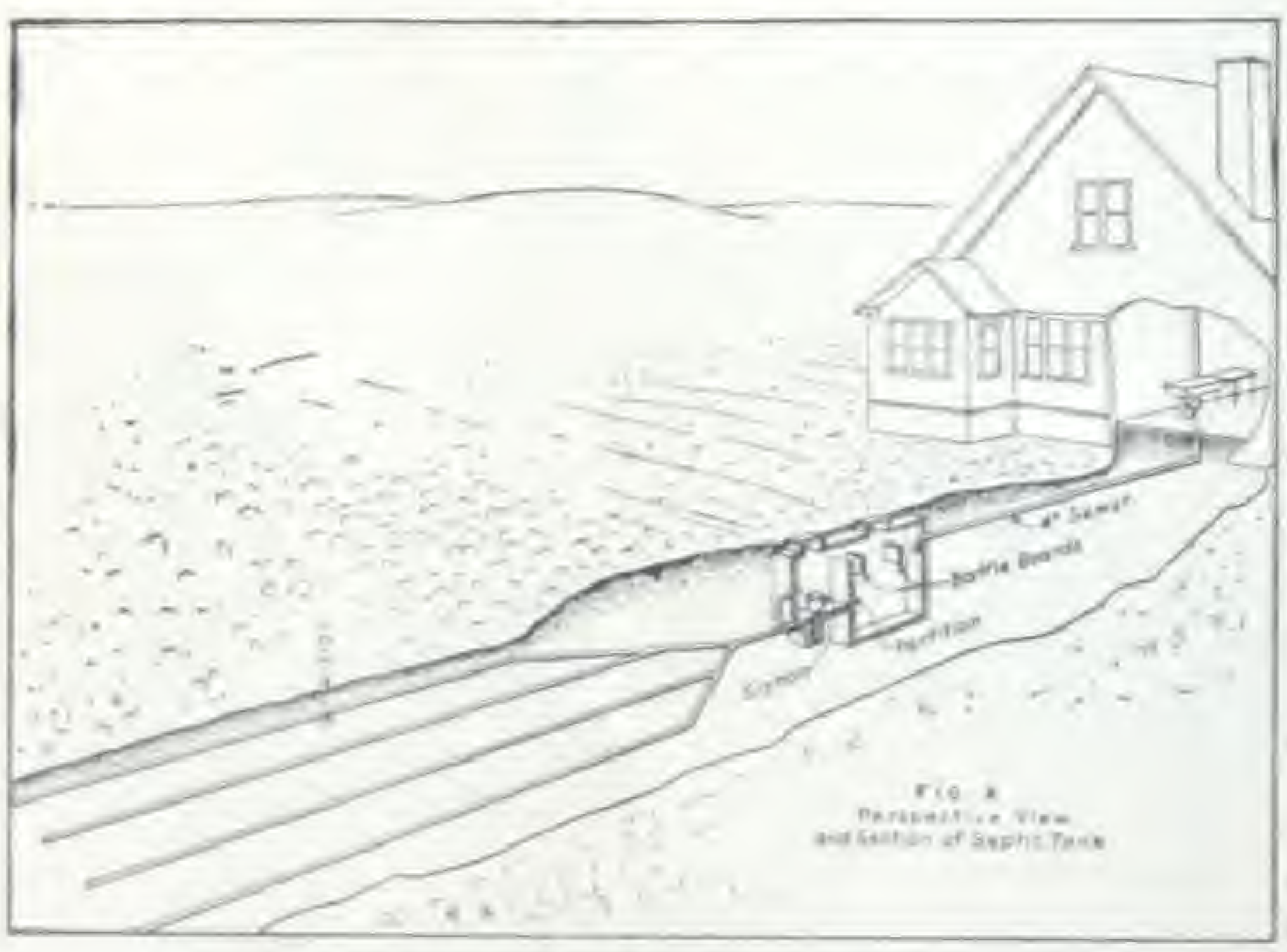

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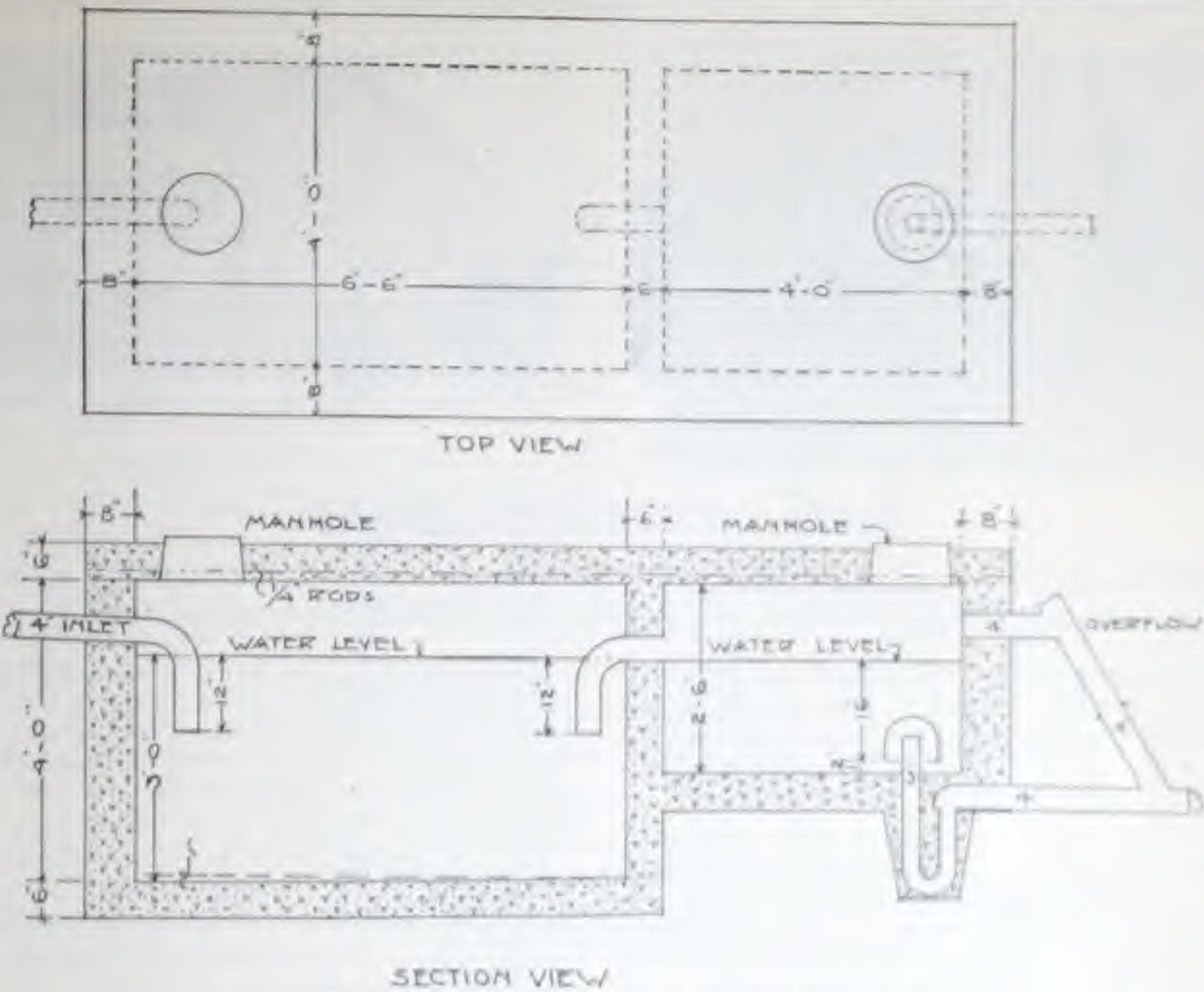

Fig. 178—Above—Construction details for the tank itself.

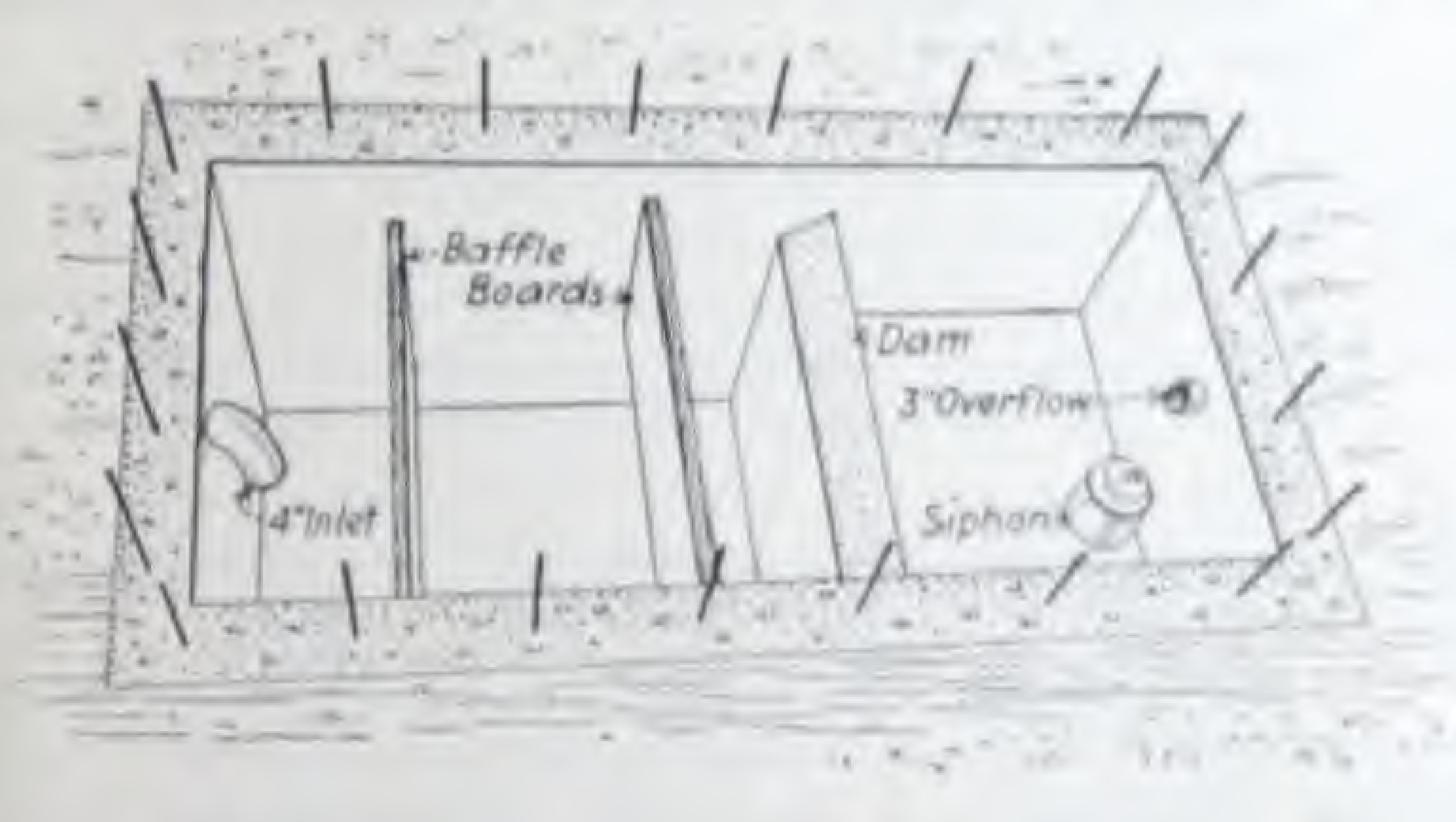

Fig. 179—To the left—View of septic tank from above showing placing reinforcement, arrangement of inlet, overflow, dam and baffle boards.

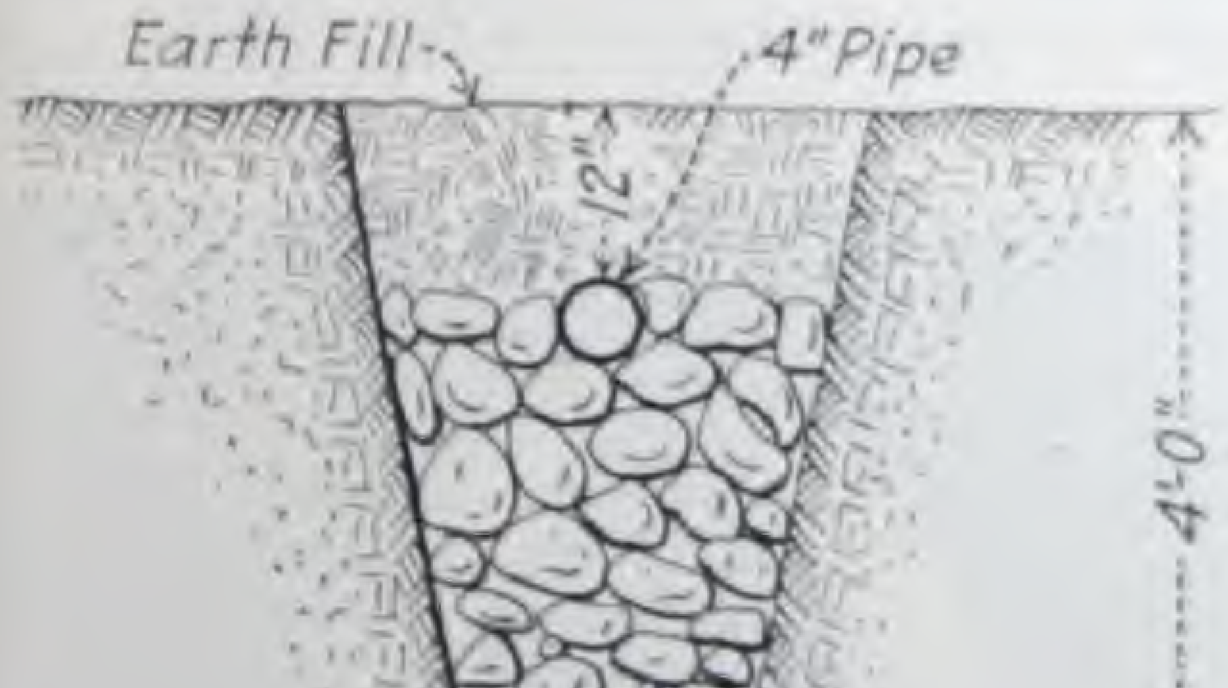

Fig. 180—Cross-section of ditch in gumbo or clay soil.

Fig. 181—Forms for manhole for septic tank.

Fig. 182A—A well built medium size garage.

Fig. 182B—A sensible and convenient concrete garage.

Small inexpensive garages

A concrete garage is low in first cost, attractive in appearance, permanent, and is easily cleaned. It requires little or no up-keep or repair, and protects the valuable contents against fire.

Size—For housing a single car, the usual size is 10 by 18 feet inside dimensions. This gives a clear space around the largest car, and provides space for a work bench fitted with a good machinist's vise and rack for tools and room for the storage of oil, gasolene, extra tires and other supplies.

It is a good plan to make the garage large enough to accommodate an additional car. The standard two-car garage is 20 by 18 feet, inside dimensions; and it is not much more expensive to build than the single car size. It provides a convenience for your visitor's car or gives you space that may be profitably used for garden tools, etc., if you like.

Construction—The small garage shown on the page opposite has concrete foundations, walls, and floor, and can be built with either a concrete or a wooden roof.

The foundations and walls are 8 inches thick and are built as one unit. The walls should extend three feet below the ground level or to below the frost line and should have a spread footing 8 inches deep. For these use a concrete mixed in the proportions of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel.

Reinforcement—The walls should be reinforced with $\frac{3}{8}$-inch rods, spaced 24 inches apart, running both vertically and horizontally and placed in the center of the wall. These rods should project a foot above the top of the wall when it is finished so that they can be bent over into the concrete roof. If the garage is to have a wooden roof, the rods need only come within an inch of the top of the wall.

The floor of the garage should be made 6 inches thick of concrete mixed in the proportions of 1 part Atlas Cement, 2 parts sand, and 4 parts of stone. Tamp the ground and wet it before laying the concrete. Slope the floor slightly toward a drain in the center. Finish the surface with a wooden float to give a surface which will not be slippery when wet.

Make the openings for the door and the windows as shown in Figure 12, page 12. Make the sides of the openings for the windows correspond to a standard size of window frame.

Do not forget to place bolts through the forms to which the hinges for the doors may be fastened.

Roof—If the single car garage is built the roof can be made of concrete, but this should not be attempted for the two-car garage as the span is too large.

The reinforcing for the roof consists of $\frac{3}{8}$-inch rods spaced $6\frac{1}{2}$ inches apart, running the narrow way of the building. That is, the rods spaced $6\frac{1}{2}$ inches on centers are 11 feet long. Running lengthwise of the building are $\frac{3}{8}$-inch rods, spaced 24 inches apart. The rods projecting from the walls should be bent over into the roof slab as shown in the plan.

Where a wooden roof is used bolts should be placed in the top of the wall while the concrete is still soft so that the sills for the roof rafters can be firmly bolted in place.

Note—Gasolene should not be stored inside the garage on account of the fire risk. The gasolene supply should be kept in a barrel buried in the ground. From this barrel should run a pipe leading to a pump inside of the garage.

Fig. 183A—Stucco garage—handsome and durable.

Fig. 183B—Concrete strips for garage approach.

Other small farm buildings on page 42.

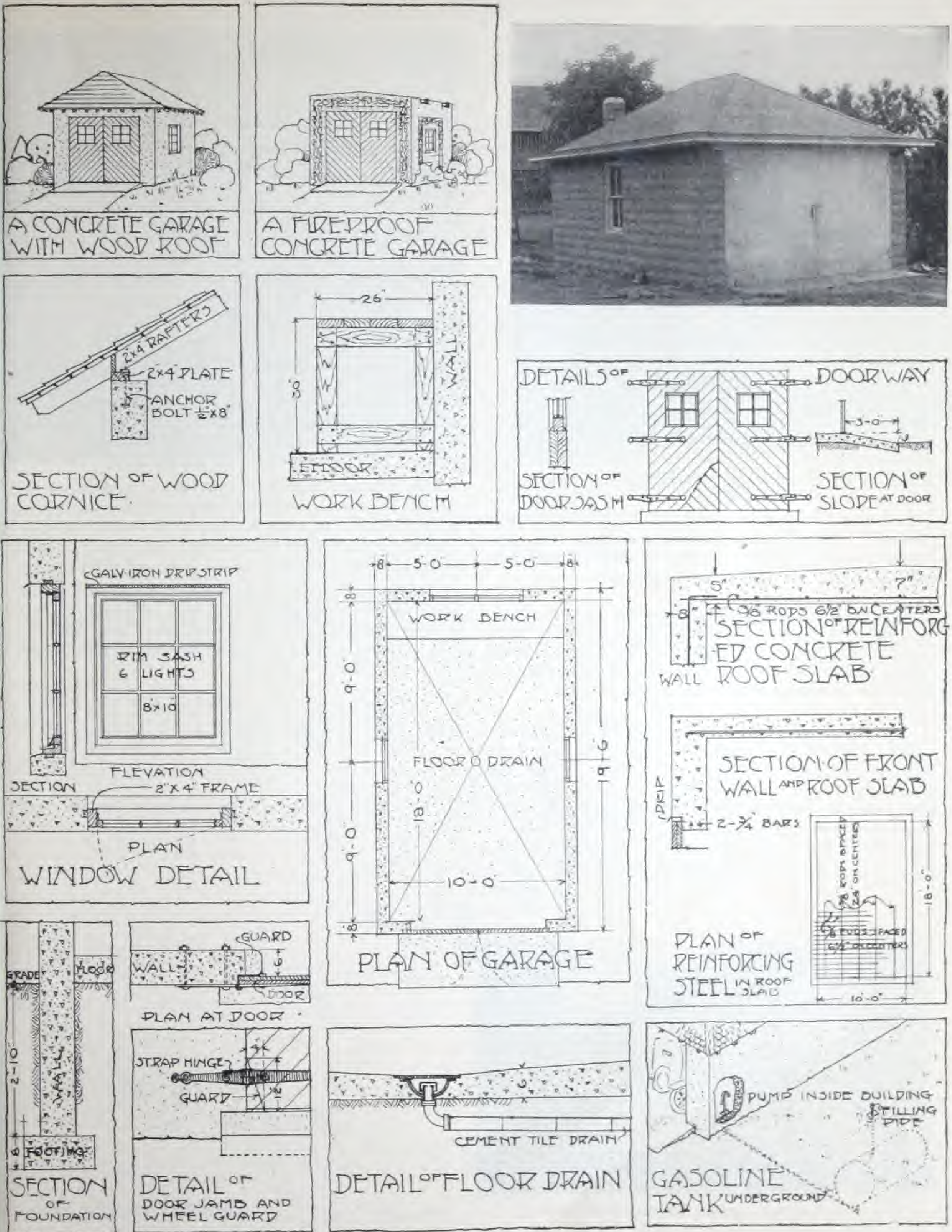

Fig. 184—Details for small garage.

General information on pavements and floors, page 28.

Concrete culverts and arch driveways

Good drainage is the fundamental principle of good roads. Drainage culverts constructed of concrete are strong, permanent and do not rot or rust. Concrete culverts are strong enough to withstand any load that will come on the road such as a threshing machine or road roller. Properly constructed, they last forever.

They are easy to build

Construction—Concrete culverts are easily constructed. The ordinary type is shown in Figures 188 and 199, and is called the square or box type. It consists of a long, square concrete box under the road with a wall at each end to keep the earth in place.

Start the construction when there is very little water in the stream. As concrete cannot be placed in moving water, it will often be necessary to divert the water while the culvert is being built. This can be done in several different ways. If the amount of water is very small the stream can be temporarily dammed. If the culvert is large enough, a flume or box of wood lined with tar paper can be used to carry the water, or a temporary channel can be built through some other section of the road, but in no case should the water be allowed to flow over newly placed concrete.

Size—It is first necessary to determine the size of the opening for the culvert. This can usually be determined from the existing culvert or some other culvert through which the stream flows. It is better to have the culvert a little too large than not large enough in case of heavy rains.

Foundations and forms—To build a culvert first excavate at least 6 inches below the existing bed of the stream for a width a little more than that of the culvert. Build the side forms for the culvert as shown in Figure 190. This form consist of 2-by-4 stakes driven into the ground and held together at the top by cross pieces. To these 2-by-4's are nailed inch boards to the height of the culvert. Then place 6 inches of concrete in the bottom of the forms.

Then construct the forms for the inside of the culvert and for the end walls. This construction is shown in Figure 190. These braces for the inside forms are nailed very lightly so that they can be easily removed after the concrete is poured.

Mixture—Use throughout a mixture of 1 part Atlas Cement, 2 parts sand, and 4 parts crushed stone or gravel. The outside forms can be removed in a few days, but the inside forms should be left in place for several weeks. They can be removed by knocking out the inside bracing and pulling out the boards forming the top and sides.

Concrete head walls are often built for pipe culverts and the construction of head walls is the same as for the culvert shown in Figure 191. The space in front of the outlet end of all culverts should be faced with concrete to prevent erosion of the soil and consequent undermining of the end of the culvert.

Reinforcement—When the span is more than 2 feet the top slab of the culvert should be reinforced. This can be done by using expanded metal lath or steel rods. The table below gives the amount of reinforcing for different lengths of span and size of top slab and walls.

Span	Thickness of top slab.	Thickness of side walls.	Mesh reinforcement in lbs. per sq. ft.	Size and spacing of round rods
2 feet	6 inches	12 inches	0 6	3/8-inch; 6 inches apart
3 "	6 "	12 "	1 2	1/2 " 6 " "
4 "	6 "	12 "	1 2	1/2 " 6 " "
5 "	8 "	12 "	1 2	1/2 " 6 " "

Fig. 186—Concrete culvert or driveway to barn.

Fig. 187 A SMALL BRIDGE SLAB

For proportioning, see page 7.

Fig. 188—Small concrete culvert of square type for a country road.

Fig. 189—Concrete crossing and culvert for wayside gutter.

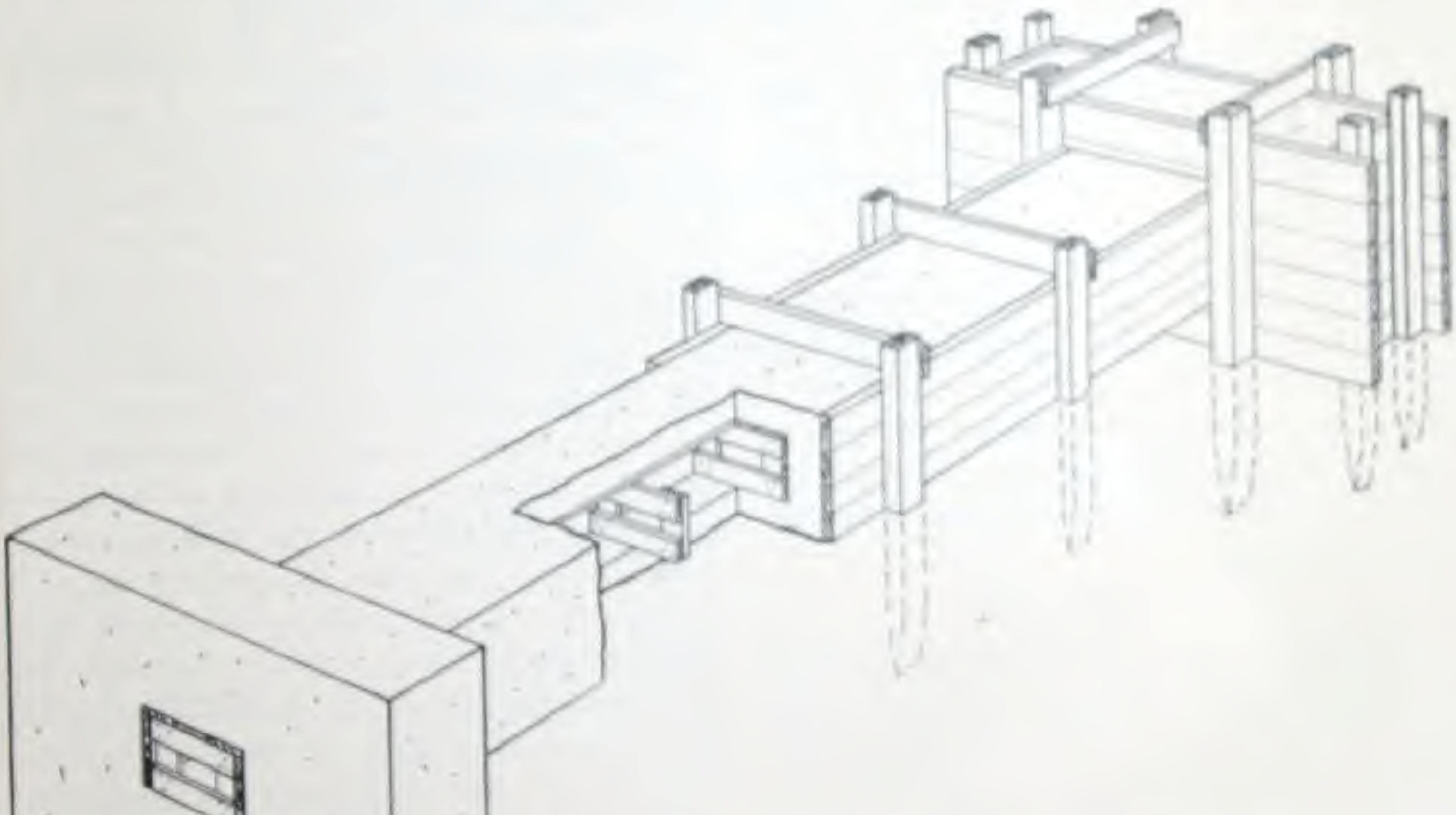

Fig. 190—Forms for building the square culvert described in the opposite page of text.

See page [illegible] for heavy retaining walls.

Chapter 4—Better country roads

Concrete Roads make farm life more profitable—more pleasant

Fig. 191—Dirt road in rainy season.

Fig. 192—Concrete road—easy hauling any time of year.

The construction of better roads from your farm to nearby towns is a matter of the greatest importance, because such roads help you make more money on your farm and render life more pleasant for you and all your family.

There should be few farmers who do not realize the need of durable highways and know all about their construction. But the fact that there are still nearly two million miles of unimproved country roads in the United States shows that a good many are yet to be converted.

We speak of "durable highways,"—we mean those that are built with a lasting hard surface—roads that follow direct lines from your farm to your market towns, that are free from heavy grades, and that make it possible for you to haul the largest loads with the greatest ease and in the shortest time every one of the 365 days in the year.

Increase on your profits

Do you realize just how valuable good roads are to you ? Take winter and early spring, for instance, when poor roads are at their worst. That is just the time when prices for produce are highest, but it is impossible or extremely difficult for you to get to town. You either lose the opportunity of profit, or else it costs you so much in time, trouble and wear-and-tear that it eats into your profits. With good roads it is much easier to get to town even in the worst weather because a good road has a hard even surface at all times—no mud, no ruts, no slipping, no skidding. They cut your costs, winter and summer, of getting to town.

Have you ever figured out what it really costs you to haul you crops to market and your purchases back from town—not the little things from the store, but coal, lumber and the heavy stuff? Other people have, and the figures show that if your roads are not hard-surfaced and in the best of condition all the year, it costs you all the way from 25 cents to 35 cents per ton per mile. If your roads were durable and hard, the cost would drop to 10 cents or 15 cents per ton per mile. Say your average haul is five miles; that means that every ton you haul into town or back to the farm costs you from 75 cents to a dollar more than it would if your roads were uniformly good. Just multiply that by the weight of your year's crops of all kinds and by the weight of the loads you haul out to the farm, and see what bad roads cost you every year. And that does not always cover the extra wear-and-tear on your horses, harness, wagon, automobiles and trucks; not to mention your nerves and temper.

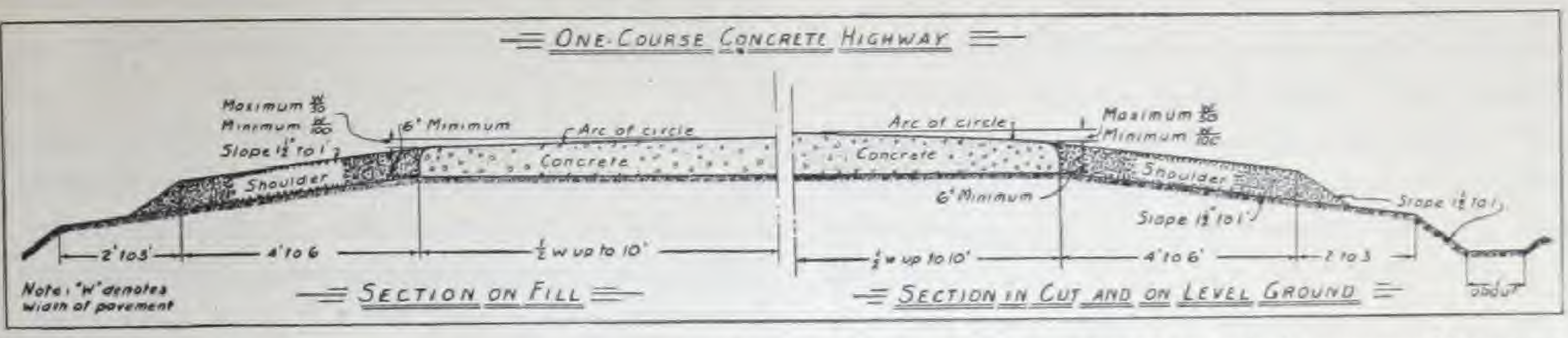

Fig. 193—Details for building one-course concrete highway, showing how the road should be arched or crowned to secure a proper surface, and how the shoulder and gutter should be built.

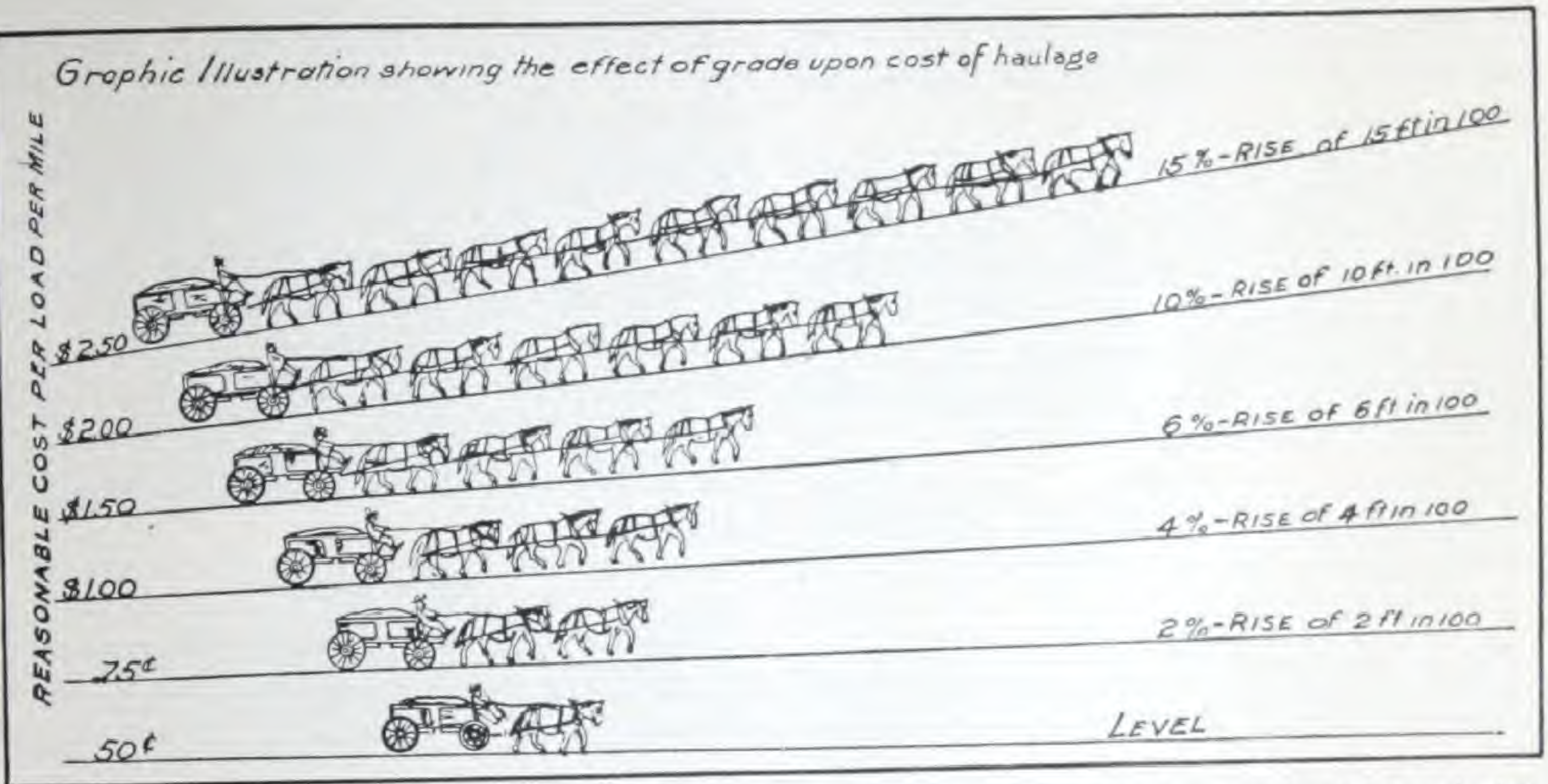

Fig. 194—To give you an idea how much grades add to the cost of haulage. When there's a grade of 6 feet in 100, haulage is *three* times as hard. For 15-foot grade in every 100, the cost of hauling is *five* times as much as it is on the level.

Fig. 195—Heavy grades raise hauling costs. Put in a concrete culvert and fill up road.

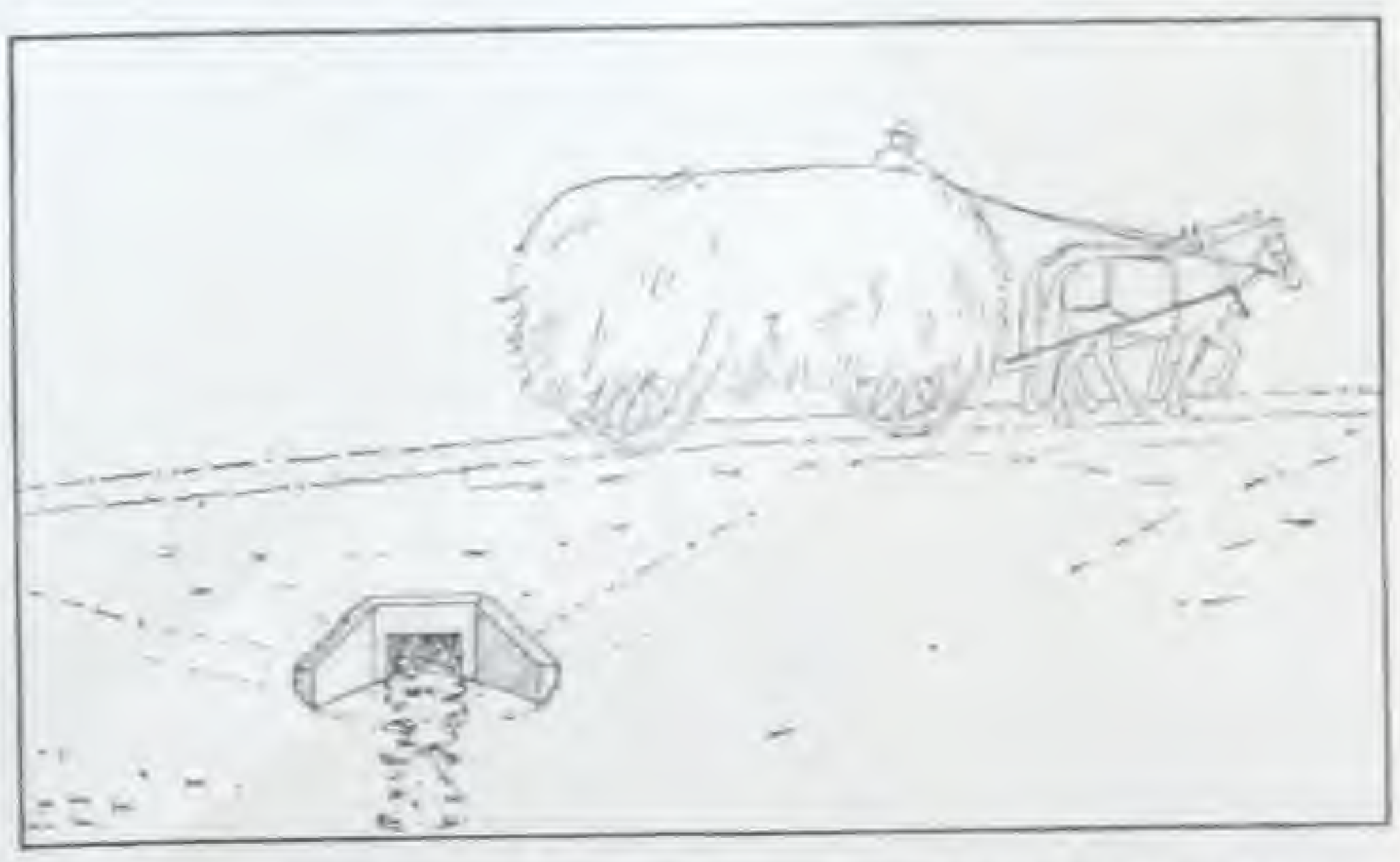

Fig. 196—Wear and tear is easily avoided by building a concrete culvert and eliminating steep grades.

For information about culverts, see page 86.

Increase land values

Good roads make your farm worth more. Suppose you yourself were going to buy some more land, and you were offered two tracts equally good in quality of soil, lie of the land and distance from town. If the prices were the same but one was on a road good 365 days in the year, and the other on a highway good sometimes but bad other times, which property would you buy? "Easy," you say, "the one on the good road, of course." Sure you would, and some day you may want to sell your farm and the buyer will ask himself the same question.

So much for the argument of profit. As for the pleasant side of the better road question, you know that an all-the-year round good road from your farm to town means better schools, church, amusements, prompt mail service and general social intercourse—the things that make life more worth the living on the farm.

"All right," you exclaim, "I'm converted. How shall we build such roads and what particular kind of road shall we build?"

How to get good roads

The answer is that you and your neighbors and all those interested in good highway construction should figure first on laying out new or straightening out old routes so as to reduce distances to a minimum. Then, because the size of a load is always fixed by steepest grade on the road, cut down the grades and fill in the low spots so as to get a level roadbed. Such work often requires tile, drains and culverts. The best are of concrete—they cost little if any more than others and last so much longer that they are really cheaper. The construction of a concrete culvert is given in detail on page 86 of this book.

Routing, grading and draining having been finished, your next problem is to select the best surfacing material. In making your choice you will naturally pick out the kind that most nearly fills the bill for a perfect road. Such a road should be hard and smooth during all seasons; free from dust and mud; not slippery for either horse-drawn or motor vehicles; a surface that will wear evenly and not become rutted or full of holes; and finally, a road that will be reasonable in first cost and easy and economical to maintain.

Better roads

Whatever material you choose, the road you get will belong to one of two types, the so-called *permanent* or the *non-permanent*. The first cost

Fig. 200—A sample of good concrete roads.

of the non-permanent road is less than that of the permanent, but the yearly maintenance expense is far greater. Furthermore, it will not last as long as the permanent road. Hence, the ultimate cost of the permanent road is much less and this means a smaller bond issue or lower taxes for building the road and maintaining it.

What it costs

Let us put this into figures. Take, for instance, a macadam road (one of the non-permanent types). Its first cost will range from $12,000 to $15,000 a mile and maintenance per mile averages as high as $1,000 a year. Now compare this with concrete. The first cost of concrete is very little more than the first cost of macadam. For upkeep concrete, in instance after instance, has averaged less than $50 a mile per year. In other words, it costs you—as a taxpayer—approximately twenty times more to maintain a macadam road than to maintain a concrete road.

The life of a macadam road is less than seven years on the average, whereas, the first concrete road built in America, twenty-four years ago, is still good for a number of years more. This is typical of the service a concrete road gives.

Repairing a non-permanent road frequently means closing the road. Not so with concrete. It is available the whole year round—every day in the year—it's not out of commission for repairs and it is always free from dust and mud, is never slippery, wears evenly, has no ruts and no holes.

If your community is planning to build new roads, ask what kind of road they think of building. Choosing the right kind will make a great difference to you in taxes—and in the service you get from the road.

Ask us for information

We will be glad to send you actual statistics on the different types of road so that you will be in position to know just what your community is getting for the money, no matter what type of road is being considered. We have a separate book on permanent roadways and it will be sent on request.

We also offer the services of our Highway and Publicity Department with its trained, competent engineers. This department will gladly co-operate with you in solving your local problems, will tell you costs and give you other necessary information.

Fig. 201—A Greenwich, Conn., road built of Portland Cement concrete.

Chapter 5—Atlas Portland Cement

Concrete dates back to the Romans. They secured good results with concrete made of a mixture of slaked lime, volcanic dust, sand and broken stone. This combination, though crude in comparison with the Portland cement concrete of the present day, produced an artificial stone which has stood the test of nearly 2,000 years. Many works and roads of concrete built in Italy and Southern France long ago are today in a fine state of preservation.

Portland cement is of modern origin. Joseph Aspdin of Leeds, England, took out a patent under date of December 15th, 1824, for the manufacture of Portland cement. It was so called because it resembled in color a well-known limestone quarried on the Island of Portland, which was then considered the hardest stone known. The manufacture of Portland cement was begun in 1825, but the progress was slow until about 1850 when, through improved methods and general recognition of its merits as a building material, its commercial success was assured.

About this time the manufacture of Portland cement was taken up by the French and Germans, and by reason of their more scientific methods, both the method of manufacture and the quality of the finished product was greatly improved. The first German Portland cement works were built in Stettin in 1855.

Portland Cement in America

Portland cement was first brought to the United States in 1865 and was first manufactured in this country in 1872.

The advance of the American Portland cement industry during the last decade has been one of the marvels of the age. From a very small beginning the Americans came very rapidly to the front and with improved methods and appliances forged ahead until today the American Portland cements are superior to any others in the world. Not only this, but the section of State of Pennsylvania in which our Northampton Mill is located, produces by itself more Portland cement today than all Germany and England combined.

In the early days in Germany and England, as well as in the United States, Portland cement was burned in dome kilns, much like those used for burning lime, the mixture in various stages being put into these kilns with alternate layers of coal or coke. The output of such a kiln was seldom more than 100 barrels a day. This process was continued until the early nineties, when The Atlas Portland Cement Company began experimenting with a steel cylindrical tube, known as the rotary kiln. It was rapidly developed by this Company and is being used today for calcining Portland cement in every mill in the United States and is gradually being adopted in Germany and England. These rotary kilns produce from 500 to 3,000 barrels per day, according to their size. More than anything else they have been instrumental in reducing the cost of manufacture to such an extent as to make Portland cement an economical building material.

Modern Portland cement is a chemical compound. It is manufactured from a mixture of two materials, one, a limestone or a softer material like chalk, which is nearly pure lime, and second—shale, which is like clay, or else clay itself. Portland cement can be manufactured

"Why you should use concrete"—pages 1-2.

anywhere that these ingredients are found. But it cannot be manufactured without the one material which is largely limestone, and the other material which is largely clay, and the two materials must be mixed in very exact proportions determined by tests, the proportions being changed as often as necessary to allow for any variation in the chemical composition of the materials. In the Lehigh Valley, Pennsylvania, where a substantial proportion of the entire output of the country is manufactured, there are extensive natural deposits of what is known as cement rock, which contains the ingredients needed in practically the proper proportions for the manufacture of Portland cement.

To manufacture Portland cement the raw materials are quarried, crushed and pulverized, mixed in the proper proportions, and the pulverized raw materials of the correct chemical composition are then fed into rotary kilns, where the mixture is burned to what is known as cement clinker.

Briefly described, a rotary kiln is a steel cylinder 6 to 12 feet in diameter and from 60 to 250 feet in length. It is continuous in operation—the raw material is fed into one end, and by reason of the inclined position of the kiln and its rotary motion the material is passed to the lower end and discharged. During the passage of this raw material from one end of the kiln to the other, perfect calcination is obtained by means of an air blast, the coal being set on fire as it enters the kiln. The clinker resulting from the burning of the raw material in this way is then cooled and pulverized and becomes the Portland cement of commerce.

Atlas Portland Cement

Wonderful as the advance of the general industry has been, the growth of The Atlas Portland Cement Company has been even more remarkable. Beginning in 1892 at Coplay, Penna., with a manufacturing capacity of 250 barrels per day, its production has steadily increased through the various plants at Northampton, Penna., Hannibal, Mo., and Hudson, N. Y., until now the productive capacity of The Atlas Portland Cement Company is more than fifty thousand barrels each day, or approximately eighteen millions a year—with a storage capacity of over four million barrels. The locations for The Atlas plants were made with two points in view, the primary consideration being proximity to the best known raw materials, and the secondary advantages from a trade standpoint. At Northampton the plant now covers about 30 acres of ground, and a fence built closely around the entire plant would enclose about 60 acres. When in full operation the Northampton plant consumes about 9,000 tons of raw rock and 2,000 tons of coal per day and employs 4,500 men. These figures, which concern the Northampton plant alone, give an idea of the enormity of the Atlas plants as a whole. By virtue of its enormous production The Atlas Portland Cement Company is able to develop and retain in its service the most skilled operating talent in the Portland cement industry, which ensures in Atlas a thoroughly reliable and uniform product.

The methods of manufacture of Portland cement developed and perfected by The Atlas Portland Cement Company have been continued with the greatest care and to such an extent that these methods are accepted as standard by practically every other cement manufacturing company. In the manufacture of Atlas Portland Cement the raw materials are carefully selected and carefully mixed after automatic weighing machines have weighed exactly the right quantity of cement rock and the right quantity of limestone. These materials are then mixed thoroughly by automatic mixers, which are con-

stantly controlled by chemists in charge of the operation, not only during the day as is done by most of the companies, but *night and day.* With this control, the mixture never varies. In fact, at the Atlas plants from the time the rock is quarried until the cement is packed into bags and barrels, the work is done by machinery controlled by experts in all its stages. In plain words, we manufacture cement scientifically and not by accident. The finished product also is constantly tested and the mill never operated for a moment without the control of the mill chemists.

One grade of cement only—the highest—is manufactured, and every barrel shipped from the Atlas mills not only meets all standard specifications for Portland cement, including those of the Bureau of Standards of the United States Government, but also complies with Atlas specifications, under which each of our mills operates and which are more severe and more exacting than the requirements of standard specifications.

Atlas-White Non-Staining Portland Cement

Atlas-White Portland Cement is a true Portland Cement. Its chemical composition is practically identical with that of Atlas Portland Cement, except that Atlas-White is free from the elements that cause the dark color of the gray or common Atlas Portland Cement. The strength of Atlas-White is equal to that of the Atlas Gray, and is guaranteed to meet the standard requirements for Portland Cement. It is, therefore, a true Portland Cement that has the same physical characteristics as the gray Atlas and may be used with the same manipulation and for the same class of work where a white color is desired.

Atlas-White was placed on the market for the purpose of supplying the demand for a high-grade white Portland Cement that was non-staining and could be used where a white or light tone effect of coloring was wanted. Its non-staining property makes it desirable for setting and pointing fine textured stone as marbles, light granite, etc. It will not stain or streak these natural rocks, and they are as firmly cemented together when bedded or set in Atlas-White as if they were one solid stone.

Atlas-White is also used in all colored cement work where true color tones are desired. It is white, and therefore gives the true color value of colored aggregates or coloring pigments. In all decorative cement work, either exterior or interior, Atlas-White has afforded the opportunity of color and soft tone effects never before realized in cement construction.

The use of Atlas-White for colored stucco and other purposes is explained in detail in other booklets issued by the Atlas Portland Cement Company, and these will be furnished upon request to those who are interested and are contemplating some work. What is said on page 19 of this book applies to problems in the use of Atlas-White as well as to Atlas Portland Cement.

In using Atlas-White it should be remembered that if a pure white effect is desired, it will be necessary to use an aggregate (sand) with it that is also white. In some localities it is difficult to find sand of a satisfactory quality or color to mix with Atlas-White Portland Cement. To obviate this difficulty the Atlas Portland Cement Company manufactures Atlas-White Mixture No. 1, Atlas-White Mixture No. 2, and Atlas-White Mixture No. 3. These are mixtures of Atlas-White Portland Cement and selected white sand, all ready to be used for mortars and facings.

Before you begin work

run your eye down this page—to make sure there's nothing you've forgotten, for it's awkard to get half-way through with a piece of work and find you haven't the necessary material or tools for the next step.

This list includes *all* the important things you would need for *all* sorts of jobs. For any *one* job, you will need only part of them.

Do you know?

how deep to excavate
how much you need of each material (see pages 8-9)
how to proportion the materials (see page 7)
what reinforcing, if any
if materials are of good quality (see pages 5 and 6)
whether you need two sets of forms
how to finish the surface (see page 16)
how to get damp-proof walls (see page 17)
how to work in cold weather (see page 18)
how to fasten new work to old (see page 17)
how to provide openings in forms for windows and doors
how to provide bolts in concrete for fastening doors, etc.
how to get corners square (see page 20)
how to protect concrete
when to remove forms (see page 13)

Have you these materials?

Atlas Portland Cement (see page 3)
Sand (see page 4)
Gravel or crushed stone (see page 5)
Clean water (see page 7)
Planks for mixing board (see page 10, paragraph 49)
Boards for forms (see page 13)
Grease for forms
Nails or bolts
Boards for runways
Wire, mesh or rods for reinforcing
Canvas for protection (see page 11)

Have you these tools?

Shovel and pick for digging
Pails and barrels for water
Screen for washing and grading (see page 5)
Hoe for mixing
Wheelbarrow for carrying
Tamper for packing (see page 11)
Ladder for tall construction
Hammer and saw
Hand level
Bit and brace
Wrench
Paint brush—to apply grease to forms
Pliers to handle wire or reinforcing metal
Template to shape surface (see page 35)
Trowel or float for finishing (see page 16)

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"The Standard by which all other makes are measured"